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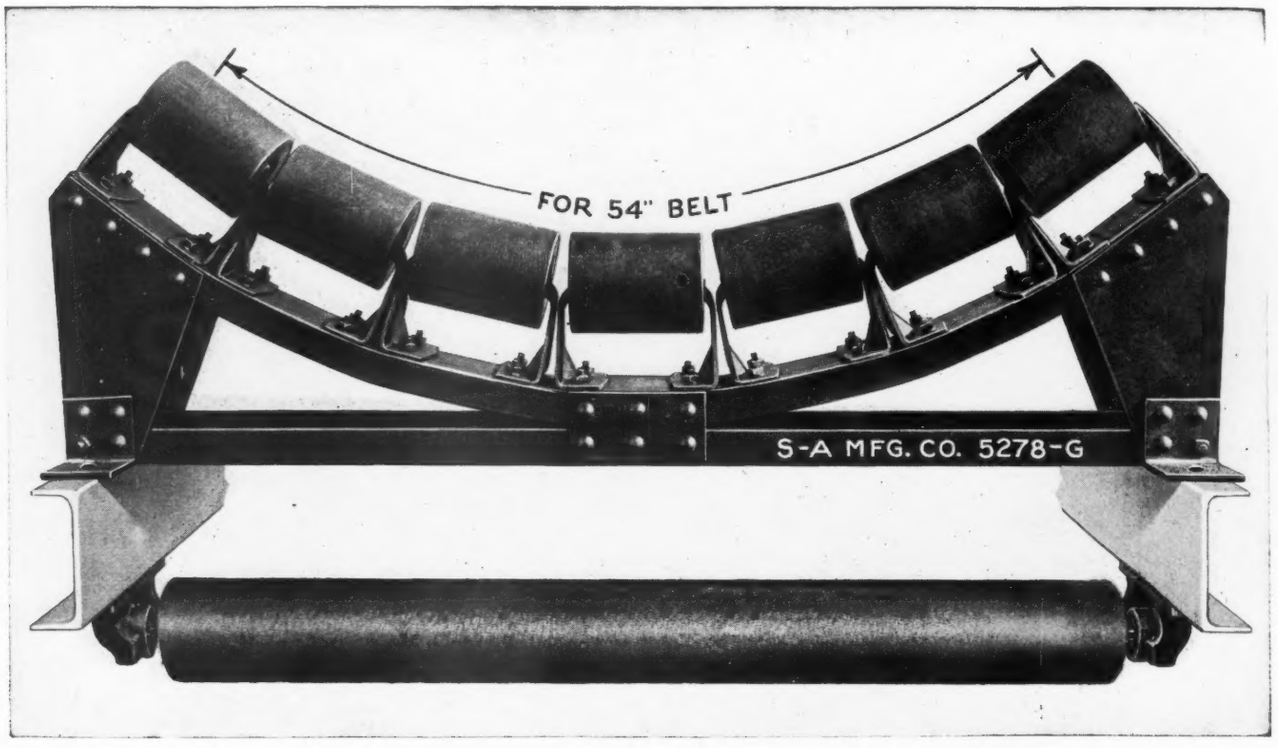
A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

September 8, 1923



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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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The Institute in Canada

THE SUMMER TRIP of the American Institute of Mining and Metallurgical Engineers to Canada was very enjoyable and noteworthy for the kindly and cordial spirit manifested not only by the Institute and their friends who liked the voyage but very especially by their good hosts, the mining men of Canada and the government representatives. As to the Institute, this spirit was guaranteed in advance by the sincere and kindly atmosphere which surrounds the present president and the present secretary of the Institute, and with such leadership the reflection of the roseate hue of good humor and helpful intent was inevitable. On the other hand, the Canadians have a rare corresponding gift of courtesy and hospitality, combined with that directness of approach and that freedom from flowery stuff which is necessary to make the citizen of the United States feel at home. The usual thoroughness of arrangements which marks the engineer was shown in the preparations that had been made by the Institute authorities and in the arrangements that were made to receive and guide the visitors, by representative men of the mining camps visited. If there were clouds anywhere except those which persistently inserted themselves between the mines and the sun, they must have been so small as to be invisible to the untrained eye.

Recognition for Mexico

WE HAVE ALWAYS FELT it somewhat unreasonable to complain about the inability of European nations to get along with one another while the United States and Mexico remained diplomatically aloof. To be sure, there has been little friction lately between this country and our southern neighbors, and it has only been a question of adjusting laws and privileges so that Americans in Mexico would have their full rights. Now this has been done, and on Aug. 31 full recognition was announced.

This gives us great pleasure and we hope that our relations may be as cordial as they are with Our Lady of the Snows to the north. Our relations with Mexico can never be as intimate as our friendship with Canada, for the bar of language and racial strain cannot be entirely surmounted, but there is no reason why the Rio Grande should be any more formidable a boundary line than the St. Lawrence.

Banditry in Mexico seems to be on the wane; one's life is now probably safer in Mexico City than it is in New York City, and the life of a mining engineer in almost any part of the southern republic is no doubt just as safe or safer than that of a negro in Georgia or a non-union man in Illinois. President Obregon has done much in cleaning up the country, and now what it needs most is capital for development. This should flow in freely, now that American rights are to be given full government protection, and we look for the early resumption of many mines that have been closed so long.

Ore Deposits of Ontario

ONTARIO has a right to be self-conscious as to its mineral wealth, and to feel that it must in the future devote its energies more and more to further development of districts not yet known and mines not yet fully explored. Within a relatively restricted area geographically it has mines which produce about 85 per cent of the world's nickel, and with enormous reserves of ore; the greatest and most promising gold district in the world; and a district, which though now in its waning days, has astonished the world with the richness and total yield of its unique silver ores.

The old impression that mines and ores must lie in the Cordilleran region of North America has been negatived, even in the slow-moving popular mind, not only by the striking though non-sensational examples like the zinc mines of New Jersey and the copper mines of Tennessee, but much more effectively by the rich and also sensational discoveries in Ontario. Moreover, there is every reason to believe that the vast territory of northern Ontario will in future yield many more finds.

The discovery of rich mines in Ontario has in general been delayed longer than the analogous discoveries in the Cordilleran region, for in the latter territory prospecting and hence discovery have been easier. Glacial drift and numerous lakes, muskeg swamps, moss, and muck covered most of the flat-lying glacier-polished rocks and veins of northern Ontario. Nevertheless, bit by bit, more of these will be discovered than are already known. Geological science, already so far advanced, is constantly on the move, and more and more proceeding conservatively, and keeping pace with actual knowledge, it will direct prospecting and development, with ever-decreasing radius of circles of probability.

Dr. Miller and his associates have been right, and therefore successful, in their policy of sticking to facts and avoiding the temptation of unwarranted theories. They have gone as far as they can, which is quite far enough for anybody to go, and have stopped short of imagination and hallucination. The popular result has been that nowhere so much as in Ontario is the importance of geology to the prospector and miner so thoroughly respected and so generally used. It is amusing, in this connection, to hear the aspiring prospector, amateur miner, and the book-soaked professor searching audibly in voluble conversation for the ultimate knowledge of ore deposits, taking as their starting point the final conclusions which veterans and careful field geologists have been able to reach; and then soaring thence to dizzy heights of speculation.

The political government of Ontario is also fully alive to the necessity of furthering the mining prosperity of the province; and therefore mining has a direct representation, the Minister of Mines, in the Cabinet of the Premier, and new mining is facilitated not only by the attentive and favorable attitude of the government but by actual building of trails, highways, and, if warranted, railways, to reach localities or camps of promise.

Control of Prices

A LOT OF IRRESPONSIBLE TALK is heard nowadays about the "control" of markets. Whole nations or groups of stock companies are indicated in no uncertain terms for "controlling" the price of a commodity. Oil, wheat, copper, silver, and other materials have sometime or other been subject to this tendency and assertions are made that the credulous swallow without a moment's thought respecting the basis upon which the assertion is advanced. Often it is the avowed purpose of a group of companies aided by the government to wrest "control" away from foreigners, no doubt on the assumption that their own "control" would be far more equitable than that of others. And so charges and counter charges fly back and forth, generally made without much foundation in fact.

Just what does control of a market imply? According to the dictionary, which should always be referred to in such matters, it applies to the exercise of restraint, influence, domination, regulation, curbing, and subjection. With that much made clear, it is pertinent to ask exactly how a nation or its parts can control the price of any commodity. In the case of a monopoly the question is easy to answer. Chile, for example, controls the principal primary supply of nitrates because that is the only country in which the mineral is found in exploitable quantities. Chile can therefore easily exercise an important regulating influence on prices. The Aluminum Company of America has a monopoly of aluminum production in the United States, so that it can virtually set its own prices for the metal it produces. It is only fair to state, however, that competition from foreign sources of supply is also a factor in the aluminum market.

How the possessors of monopolies exercise their power we shall not consider here, but merely make acknowledgement of their ability to do so. In other words complete or almost complete preponderance in the ownership of a commodity source will enable the owner to set prices regardless of other conditions. It is somewhat like the granting of a patent, which gives the owner exclusive rights to the use or manufacture of a certain article.

Commodities may also be controlled by business groups or countries financially powerful enough to acquire large supplies and to hold them for disposal at their own will. For example, the bismuth market is controlled by an important British company, which sets prices for the whole world. It has shown its strength in the past in meeting unwanted competition with such severe cuts in price that its competitors have been unable to stand the gaff. But the great world commodities like wheat, cotton, copper, corn, silver, lead, and zinc are not amenable to such an easy control, for the simple reason that the cost of maintaining such control is prohibitive, requiring tremendous capital expenditures.

Swift retribution generally falls to the lot of those who attempt to make corners. Yet sweeping accusations of price fixing still persist. Thus we find a recent bulletin of the New South Wales Department of Mines stating that "The industry [copper] has been handicapped in Australia owing to several causes, principal among which are the fixing of copper prices in England and the United States." Heaven knows the copper producers in this country are displaying poor wisdom and attaining poor results if the present copper market is any measure of their price-fixing abilities.

The copper industry did influence prices when it shut down a year ago and kept fresh supplies of metal from the market. Similarly, the zinc miners a few weeks ago decreased production in the Middle West and helped to uphold the market. These are two good illustrations of how a market may be controlled, but note that they have to do directly with the supply of a commodity. Is this the thought behind the critics of silver who assert that Great Britain controls the price of silver? We think not. A popular conception among miners is that a group of Englishmen get together each day and say, "The price of silver today will be 65c. Tomorrow let us make it 64c. for all deliveries and next week perhaps we shall bring it down to 60c." Surely that is hardly a logical deduction, but many who should know better believe it.

Control of the silver market rests in England in the sense that London leads the world in the importance of the transactions of the silver business there. It receives the bulk of the commissions on the sales and purchases made, but it cannot with a wave of the hand decide that silver prices today shall be so much and tomorrow a cent more or a cent less. London would quickly lose its leadership if it did that.

Assertions as to control should be carefully analyzed and substantiated before receiving acceptance, or, like the indictment of a people, they are sure to be quite unwarranted.

Hoisting Ore in the Tri-State District

HERE AND THERE about the country the visitor to the various mining districts occasionally sees something that is markedly different from anything he has noted elsewhere. If he keeps a diary of his travels he probably sets down hoisting practice in the Joplin zinc district as among the seven wonders of the mining world. It looks crude and possibly is crude, but it gets results, and, besides, it is exceedingly interesting. It means team work at each shaft, the team consisting of the "hoisterman" and the "tub-hooker," the two of whom work in such complete unison with each other that they almost seem like soulmates.

Be it known that the greater part of the Tri-state district's zinc ore—and the district produces 70 per cent of the country's slab zinc—is hoisted in "tubs" or cans, that is, steel buckets that hang freely in the shaft and are raised and lowered without the aid of guides or crosshead. From his station at the hoist at the top of the "derrick" or headframe, where the tub is dumped, the hoisterman may look down the shaft and watch his moving load come and go. Below him at the bottom, 300 ft. perhaps, and directly beneath the descending bucket, stands the other member of the team, the tub-hooker. A direct-motion hoist is used, and the start and stoppage of the bucket are decisively snappy. Just as the tub seems about to knock the tub-hooker "for a goal" it stops and then is slowly lowered to the floor. As the rope slackens, the hook is detached from the bale and with the same motion of the tub-hooker's arm is swung over, attached to a loaded tub, and up the latter goes without any signaling whatever, the hoisterman at the top knowing just how long the transfer should take and reversing at the proper instant. It is said to be considered a disgrace for the tub-hooker to

let the hook get away from him without a tub. The bucket is dumped just as snappily at the top, in the usual manner, by inserting a hook in the bottom ring and lowering. Thus the zinc ore of the district reaches daylight.

A word about the "skiddoo" bell. If the hoisterman detects that something is wrong as the load is coming up, he simply presses this bell with his knee, thus warning his buddy at the bottom to get out from under. Thus a proper regard for the precepts of the National Safety Council is displayed.

Some remarkable records have been made. Last spring at the Premier mine, in Picher, 10,407 cans, containing 6,244 tons, were hoisted by two crews of hoistermen and tub-hookers in six working days of sixteen hours. This was one can every 33½ seconds, the shaft being 300 ft. deep.

Skips have been tried from time to time and are still in use in places. Thus far, in general, they have not seemed as suitable to local conditions as the cans are, though the future may see this changed. At any rate efficiency engineers can put the Joplin hoisting practice down into their notes as something that, though seemingly crude, will be hard to beat, everything considered.

Neighborliness

IN THESE DAYS when the inability of nations to get along with each other is upsetting everything in general, it is too bad that gold-mining companies operating near each other cannot conduct their affairs with hearty cordiality. It is conceivable that producers of asbestos or feldspar, for instance, who must compete with each other for their market, might not feel justified in helping their neighbors. Such an attitude may be understood even if condemned; but with gold the situation is entirely different. Suppose a company has a gold mine. Another company comes along and opens an exceptionally large and rich mine alongside it. The first enterprise is not injured, but, rather, is benefited. Each can sell every ounce of gold it produces at a standard price without any expense but delivery to the mint. And usually any improvement in methods of mining or milling, any economies effected by the new company, will be reflected in greater profits by the older.

There happens to be (somewhere in the western hemisphere, not to be too specific) a gold district where five or six companies have mines and mills situated along a single belt of rich gold-bearing veins. Their problems are all virtually identical, yet they are poor neighbors. We understand that there is no quarreling among them, but they do not co-operate for their mutual advantage. One superintendent has developed a scheme for improving the extraction in his mill, but none of the others have adopted the plan. Whether because, as we have been told, they do not care to acknowledge the success of the originator of the method, or for some other reason, we do not know. At any rate they have not even given it a trial.

One manager admits that he has no information except hearsay concerning the work of his neighbor, who is approaching the common boundary line between them with his underground workings on several levels. Yet there are a number of veins running through both properties and a definite knowledge of the character, size, and richness of these in the other property certainly would be a big help to the first manager, who has several hundred feet to go before he reaches the boundary.

One superintendent would rather shut down half of his mill for a week than incur any obligation by borrowing a motor or some other piece of machinery from his neighbor. The community is small and isolated, and yet we are told that the managers never get together, as they do in many districts we could name, and talk over their mutual problems.

We once knew of two adjoining gold mines where the managers spent the best part of two years running around the state to attend court over a dispute involving a few hundred tons of ore that was alleged to have been wrongfully mined by one of them. The trouble grew out of a small personal quarrel between the two men. Operations of both companies suffered from attendant disorganization, until finally one got a new manager, and the lawsuit was quickly settled out of court. Everybody lost but the lawyers. There is nothing like this in the district which we were discussing, but the episode illustrates the unnecessary trouble and the economic waste that can come from petty quarrels.

It may be good business policy to be independent, to mind your own business and let the other fellow mind his, to grant no favors and to expect none. Perhaps it is a better policy to be human; to help the other fellow, at least when it costs you nothing; and to take help from him, at least when it costs him nothing. Try being neighborly even in business.

Sales of War Stocks a Success

ANNOUNCEMENT in a recent issue of the *Journal-Press* that trench hats, those extremely durable if uncomfortable headpieces that were used in France, have been purchased in quantity by a mining company and will be used by miners in certain work, brings to mind the enormous amount of war stores that have been marketed for civilian use in the last four years. The government does not always bungle, and in gradually disposing of all this surplus material has shown much wisdom. Certainly, no great injury has been done to normal business, despite the fact that over two and one-half billion dollars' worth of goods have been sold. Most of it was sold at a loss, to be sure, for it was purchased at a time of stress when delivery was more important than price. But there was certainly no great lack of sagacity when several million pounds of copper was sold last March for over 17c. per pound.

Most of the goods sold have been bargains. A large amount has been released through sales to stores which have made a specialty of retailing to the ultimate consumer. One does not have to go far in a city to find an "army and navy outlet" store, where clothing and camp and household equipment can be obtained at reasonable prices. Also, many large industrial enterprises, such as mining companies, have taken advantage of the opportunity to purchase much necessary equipment at low prices.

In 1919 and 1920 the perishables were disposed of, canned food and bacon, and now, toward the end of the sales, the tag ends of the more permanent equipment and supplies are being cleaned up. It was a great job, well done.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

"Getting Around the Labor Shortage"

THE EDITOR:

Sir—An article in the *Journal-Press* of Aug. 11, by George L. Walker, under the heading of "Getting Around the Labor Shortage," commended itself to me as one of the most sensible schemes that I have seen put forth for attaining the object sought. The final words struck me as being just the right suggestion: "Instead of firing those who cannot do a full day's work, why not educate them?" I think that firing, with and without tangible reasons, is in part responsible for the shortage of good miners today.

Admitted that there are many "stiffs" who don't want to learn and whose sole object is to get a few dollars together for a road stake. Any man with a little more "gray matter" than an ape can surely weed these out. "Gray matter"—or brains—should be an asset demanded of every prospective candidate for the job of shift boss. Too many shift bosses lack this. They have got their job through their ability to do a hard day's work, but very often their value ends there. It is not always the good worker that, as a shift boss, can pass his value on to the men under him, and get good work from them also. The young college man with a year or so of experience in a good mine, and working under a good level-headed foreman, makes the best of "shifters."

I do not expect that I will find any so-called "practical" men to agree with me, particularly those of the Captain Dick type. They were good men in the days of the single-jack, but things have advanced, and men must advance with them. A well-known efficiency expert once said to me, "If you want work done well, make it easy to do."

The first thing necessary, to make a job easy for a man to do, is that he should know exactly how to set about it—in the right way.

I have observed in most mines that I have worked in, many instances where work and conditions could be made easier, to the mutual benefit of the company and the worker. To the engineer or an intelligent foreman these would be apparent, but "there was no time to do it" . . . "We can't stop this level—it will affect our daily output." So the track remained in a sorry condition, twisted and "off gage," bad points, and so on. One car in ten got off and upset. The traffic was delayed fifteen to twenty minutes each trip, and the trammers were disgusted with their job, and drew their time after a shift's or two shifts' work. Result, new men, and more inefficiency.

Get the track fixed—perfect in gage and curves and points. Have the cars fitted with the easiest-running type of bearing procurable. Keep them greased automatically or by hand—that's the remedy in this case, by way of making the job easy to do and keeping the men on the job. The longer they remain the more proficient they become.

In these days of applied science and machinery, brute force does not count for much. Every man should use his head—work from the neck up—if he wants to make his work as easy for himself as possible, and of value to his employer. Young husky men who present themselves for a job at the mines today are the sole material that industry depends on for its miners of the near future. Take them on, give them a chance—two chances if necessary. Appoint good, level-headed men to teach them the rudiments of their job.

The more a man knows about his job the more interest and pride he takes in the doing of it. D. L.

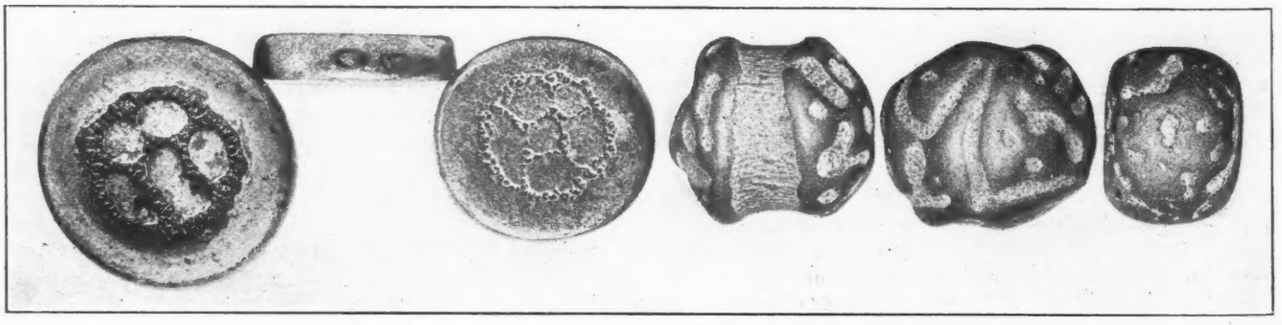
San Francisco.

Peculiar Shapes of Grinding Balls

THE EDITOR:

Sir—Inclosed are photographs of steel balls after long use in a ball mill. These balls were picked up in the southeast Missouri lead belt and are not uncommon shapes. No doubt some of the manufacturers have studied these shapes and know why the round ball wears in this manner. Discussion may prove interesting. CHARLES Y. CLAYTON.

Rolla, Mo.



Steel balls after long use in a ball mill. How do they get this way?

Concentrating and Separating Pyrite and Ferriferous Blende

Weatherby Magnetic Tables Used at the Northern Ore Co.'s Plant at Edwards, N. Y., Prove Highly Efficient Machines—Applicability to Other Types of Ore Indicated —High-intensity Dry Magnetic Separator Has Also Just Been Developed

By Edward H. Robie
Assistant Editor

OFTEN THE MOST INTERESTING metallurgical practice can be observed in a plant that is off the beaten track and not often visited by those seeking information and ideas. Such a plant is that of the Northern Ore Co. at Edwards, St. Lawrence County, N. Y. Until the article descriptive of the geology of the company's deposits appeared in the July 21 issue of the *Journal-Press*, it is likely that only a very small number of people knew that there is a mine and concentrator in northern New York producing about 2,000,000 lb. of zinc a month. There are no other zinc mines or commercial deposits of zinc in the vicinity, and the district looks more like a farming country than a mining region. Were it not for the numerous talc mines and mills, the Northern Ore Co. would stand alone as a mineral producer in that part of the state.

As was mentioned in the previous article, the two most important minerals are pyrite and a ferriferous variety of sphalerite known as "black jack." The sphalerite contains ferrous iron in chemical combination with the zinc sulphide, and in some specimens there is an indication that the sphalerite is impregnated with pyrrhotite, so that the analysis of the pure mineral is about 62 per cent of zinc, 33 per cent of sulphur, and 5 per cent of iron. The average analysis of the mill feed is about 43 per cent of mineral, comprising 17 per cent zinc, 9 per cent iron, 17 per cent sulphur, and 0.12 per cent lead, the gangue making up the other 57 per cent, of which 16 per cent is silica, 11 per cent calcium oxide, and 13 per cent magnesia. There are no extraordinary difficulties in separating the mineral from the gangue by ordinary table concentration, but it was a struggle of several years to separate the zinc from the pyrite, and the machines finally developed for doing the trick are in use nowhere else in the world. As their applicability is not limited to this particular ore, however, a full understanding of their construction and operation should prove of value to many other metallurgical engineers.

One of the first methods tried out to separate the iron and zinc sulphides was roasting the ore, making the pyrite magnetic, and then to remove the pyrite by ordinary magnetic separators. The objections to this procedure were, first, the cost of drying and roasting the ore; second, the difficulty of controlling the roast properly; third, the very dusty operation of the magnetic separating plant; fourth, the loss of valuable sulphur, which passed into the air as sulphur dioxide; and fifth, the damage to the vegetation from the fumes. The property was too far from market to justify a sulphuric-acid plant, and the capital investment would have been too heavy. This method of treatment hardly passed the experimental stage. It was then decided to make use of the slight magnetic quality of this variety of sphalerite, and to leave the pyrite in its unroasted and non-magnetic condition.

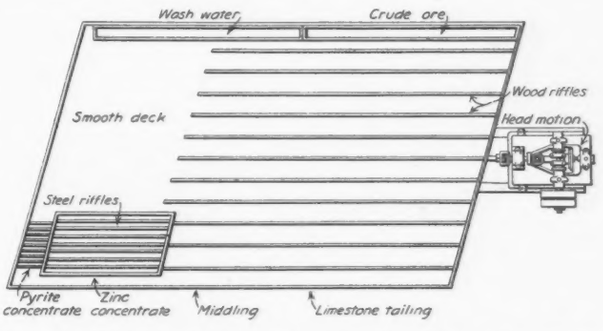


Fig. 1—The first design of magnetic table. Separation of mineral from gangue, and then of pyrite from sphalerite was all done on one machine in the early work.

The concentrate containing the mixed minerals was wet and no magnetic separator was available that would work efficiently on material of this kind. A wet electromagnetic machine was then devised by Joseph Weatherby, by inserting steel riffles at the concentrate end of a common concentrating table and putting a huge magnet over it. Fig. 1 shows the scheme. The table deck was securely fastened down, the magnet being suspended from above. The idea was to concentrate the crude ore and separate the two sulphides on the one machine. The attraction of the magnet for the steel portion of the deck is said to have raised the mill floor on which the table stood, when the current was first turned on. The apparatus worked, but it seemed advisable to concentrate first on tables and jigs, and to part the two minerals later with machines designed for this work alone.

The essential characteristics of the present flow sheet are shown in Fig. 2. The milling plant is constructed on a flat site, making the use of eighteen bucket elevators necessary, a rather expensive item. The ore passes from a 500-ton mill bin to a Blake crusher on the first floor, which reduces the material from a maximum of 8 in. to 2 in. The product is then elevated and conveyed to a trommel, first passing under an electromagnet to take out stray iron. The trommel is of cylindrical design, with ½-in. punched holes. The oversize is further ground in a Symons disk crusher, the discharge from which unites with the trommel

undersize, and is elevated to a steel ore tank. This crushed-ore storage tank allows the necessary repairs to be made to the disk crusher without shutting down the rest of the mill; were it not provided, heavy-duty rolls would be used, which would make more slime. Not

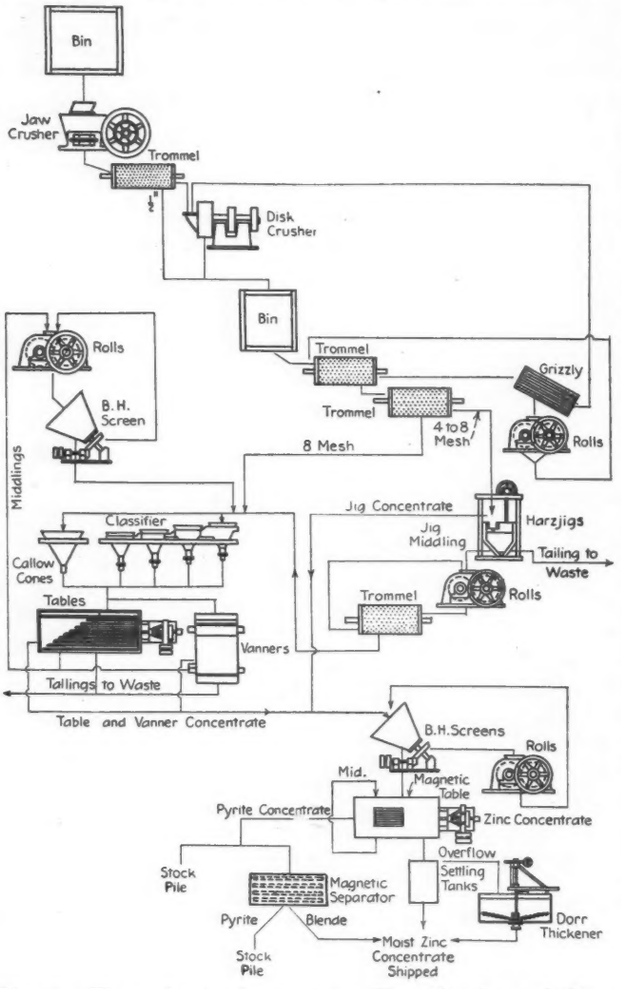


Fig. 2—Flow sheet of present mill. No fine-grinding machines other than rolls are used. All concentration is on various types of tables.

all of the material drawn from this tank is of sufficiently small size for treatment, so it is passed over another trommel fitted with 4-mesh woven-wire screens, the oversize from which is ground by Allis-Chalmers 16x30-in. rolls. Thus all of the mill feed is ground to pass 4 mesh.

Harz Jigs Used for Concentrating the Coarser Material

The coarser ore, between 4 and 8 mesh, passes to a three-compartment Harz jig. The main frame of the jig is 8x8-in. hard pine, with sides of the same wood, 3x8 in. The jig is bolted together in a substantial manner with ¾- and 1-in. steel rods (Ustler special and S.A.E. 3520 steel alloy). Nickel-steel alloys are used in all important bolts in mill-repair work; the added cost is slight, the tensile strength is 200,000 lb. or better, and the bolts never break again when replaced by these alloy steels. They cost 7@8c. per lb. against 3@3½c. for common mild steel rods. Broken bolts in rolls, table head motions, and similar parts of the mill equipment cost money for the labor of replacement and a lot more money for the shutdown delay. The jig is lined with ⅜-in. steel plate between compartments to prevent wear.

All concentrates come through the hutch. For bedding, $\frac{7}{16}$-in. screen punchings are used, bedding being added or taken off to regulate the grade of concentrates, while operating. When the screens are cleaned, the steel punchings are recovered by a hand electromagnet. This material is found better than natural ore for bedding, for closer work can be done and a more uniform grade of concentrate produced. Furthermore, large pieces of ore are often flat or some other objectionable shape, so that they reduce the effective jig screen area and cut down the capacity of the machine.

The jigs are successful in making a coarse tailing, which, as it contains only 3 per cent of zinc, is allowed to go to waste. The material too fine for jig treatment is sized in hydraulic classifiers and concentrated on tables, classifiers preceding all tables. The first four classifiers are of the box launder type, and are home-made. The sorting tubes are made of pipe and fittings as shown in Fig. 3, and give a combined upward and whirling motion. Regulation is effected by increasing or decreasing the hydraulic water and size of spigot.

Fig. 2 gives the general scheme of pulp flow, the details not being reproduced owing to their complexity. In the mill, classification and screening are carried to an extreme, the feed to practically every table being slightly different. This has been found to give the best results metallurgically, though numerous cone classifiers and dewatering devices are necessary, six of these being 8-ft. Callow cones. There are also two 30-ft. Dorr thickeners. For the coarser material, four of the old reliable Bunker Hill screens serve admirably, these being equipped with 12- to 18-mesh screens. Rolls are used exclusively for the fine crushing preparatory to tabling, and the absence of ball or tube mills is an interesting feature of the plant. Rolls are considered to be better adapted to small tonnages, and are easier and cheaper to repair. They are also thought

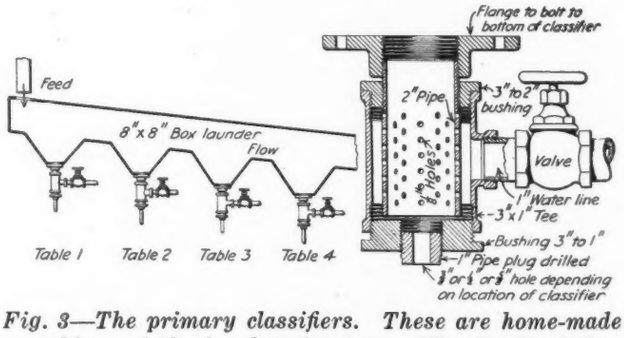


Fig. 3—The primary classifiers. These are home-made machines of the box-launder type. The detail of the sorting tube on these classifiers is shown at the right. The ⅜-in. holes in the 2-in. pipe are drilled with a slight inclination to the left of the true radial line, to give a whirling motion.

to produce less slime, and as 55 per cent of all the zinc lost in the mill tailing is minus 250 mesh, the production of slime is avoided wherever possible, by careful stage crushing and other means. The limestone is tough, but the sphalerite is very brittle, and the ore often runs 22 to 24 per cent zinc for days at a time. If a new mill were built, a rod mill might be considered, but not a ball mill. Of the several makes of rolls used,

those made by the Allis-Chalmers company have proved most serviceable.

The mill now contains four Deister Plat-O tables, six Butchart tables, eight Deister Overstroms, and two Isbell vanners. Three more vanners are being added for minus-100-mesh feed. All tables have been selected after competitive tests on the size of feed they are to treat. The practice is to use the Plat-O tables on the coarser sizes. The Butcharts are used as follow-up tables, treating middling mostly, but in some instances for original feed. The Deister Plat-O shows the biggest tonnage capacity and has been found to be an ideal roughing table, being sensitive to sudden changes in the rate of feed; its head motion is inclosed and runs in oil; it is rugged, gives little trouble, and has a snappy stroke. Its tilting adjustment is considered too slow, however.

Butchart Table an Efficient Rougher

The Butchart table with the Butchart "S" riffling has been found to be an excellent rougher, but it will not handle so much tonnage as the Plat-O. The table is not sensitive to sudden changes in the rate of feed. Its tilting adjustment is rapid and enables the operator quickly to tilt his table steeper if the feed diminishes and limestone begins to appear in the concentrate. The table is rugged; the head motion is inclosed and runs in oil, and repairs to the new type are materially less than they were with the old model. The stroke is good.

The Deister Overstrom tables are used on the finer sizes, 30 mesh to 100 mesh. They have excellent head motions running in oil, require little attention, produce clean concentrate, and their percentage of recovery is good. They have displaced two other makes of tables, after careful tests, on these finer sizes.

The method of riffling the Plat-O tables is of interest. In Fig. 4, in zone *A* are the drawing riffles—fine light strips $\frac{1}{16}$ in. high, whose sole duty it is to guide the concentrate to the end of the table. In zone *B* are heavy riffles of hardwood $\frac{3}{8}$ to $\frac{1}{2}$ in. by $\frac{3}{4}$ to 1 in. In this zone the plateau starts its rise, which is completed in zone *A*. The concentrate here is mixed with a small percentage of middling and also some fine gangue that has traveled along on the deck between the heavy sulphide grains. Additional riffles are introduced here to intensify the hydraulic action; also to choke the space between riffles so as to have room in the grooves for concentrate only. The effect is to stir up the concentrate, forcing the middling and more especially the fine gangue to the surface, where the wash water quickly removes it.

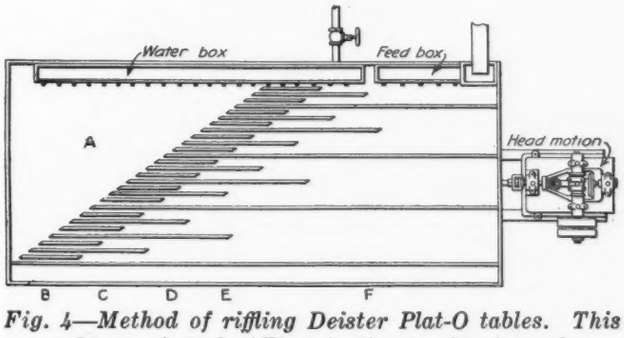


Fig. 4—Method of riffling Deister Plat-O tables. This scheme of pool riffling is the result of much experimentation at the Northern Ore Co.'s plant.

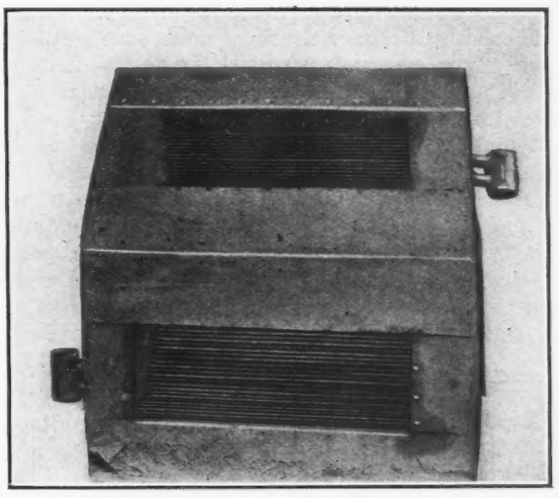


Fig 5.—Deck of magnetic table. This is a view looking down on one of the spare decks in the yard.

Zone *C* is the hydraulic cleaning zone for middling. When water rises from the deck to pass over a riffle, an action goes on similar to that in a hydraulic classifier. This zone has middling and concentrate traveling through it, the pure gangue having left the table at zones *D* and *E*. This is true with the exception of very fine particles of gangue that hide under or between the sulphides as they progress along the deck. Their favorite haunt is the upper corner where the riffle joins the deck; beveling the upper side of the riffle does much to overcome this.

In zone *C* the difference in weight between the concentrate and middling is not sufficient to force the pure middling to the surface with the panning or shaking action alone, so additional riffles are introduced to give a successive series of upward water currents which pulsate, owing to the motion of the table. Zone *D* is the cleaning zone for tailing, where most of the tailing is made, and where it is somewhat richer than at zone *E*. Every time the feed rolls over a riffle it has a chance to restratify, and an additional riffle is introduced to stir up any free gangue traveling low, next to the deck. Zone *E* is the primary zone for tailing; here, due to the absence of rising currents, the shaking action of the table raises the clean gangue to the top, all sulphide minerals settling to the deck. The action is the same as shaking a pan of shot and sand together. Lean tailing discharges in zone *E*. Zone *F* is water.

The tables riffled as described are given a hydraulic semi-classified feed, of 8 mesh and finer. The system should work well on unclassified feed, but has never been tried on such material at this plant.

No difficulty is experienced with the insignificant amount of lead in the ore, for this shows up readily on the tables as a thin steel-blue band which is sent out of the mill with the tailing. Not sufficient is present to make its segregation and recovery worth while. The finer sizes of tailing receive a final treatment on Deister Overstrom tables in a separate building.

Separation by Weatherby Magnetic Tables

The concentrates from the tables contain practically all of the pyrite as well as the sphalerite, though the latter, by the elimination of the gangue, has been brought up to about 30 per cent zinc. The Weatherby

magnetic tables, which separate the two minerals in the table concentrates, are the most novel equipment in the plant. They are made by the Electric Ore Separating Co. Their construction will be made clear by the accompanying Figs. 5, 6, and 7. Unfortunately, due to the vibration of the floor, it was impossible to obtain a clear photograph of one of these tables, and Fig. 7 gives a somewhat futuristic idea of the appearance of the apparatus. The deck of the table is of aluminum, with brass screws and steel riffling. The table is operated by a standard Wilfley head motion, the stroke being 1 in., 250 strokes per minute. Directly above and below that part of the deck containing the steel

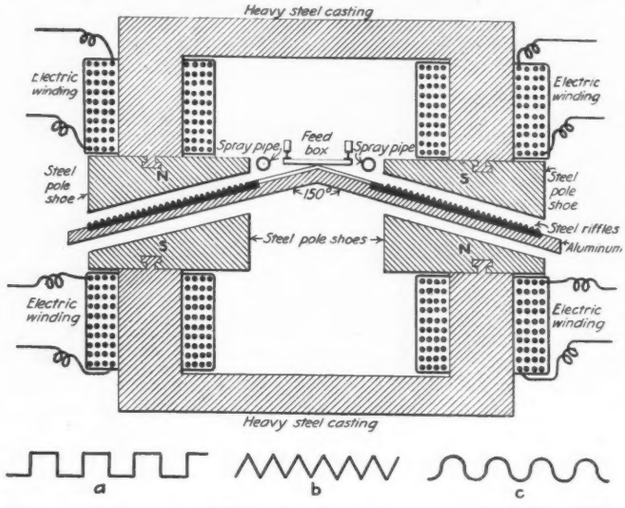


Fig. 6—Diagram of Weatherby wet magnetic table. The cross-sectional view shows the position of the magnets in relation to the decks. The types of riffling are given at the bottom of the cut.

riffling, but not extending to the end of this riffling, are mounted two electromagnets, the one below being of opposite polarity from the one above. The current required is 15 amperes at 110 volts per machine. About 1 hp. is required to drive the head motion. The top of the steel riffles is somewhat nearer the upper magnet.

The small size of the deck of these magnetic tables is of interest, the over-all dimensions being only 4x4 ft. Larger machines could be built, and there are two sizes in the mill now, but the increase in size does not seem to increase the capacity materially. It is difficult to radiate the heat from too large a coil winding, but this could probably be overcome.

Several forms of riffling have been tried, such as are shown at the bottom of Fig. 6. The rounded riffles (*c*) have proved the best, and it has also been found advisable to have the riffles somewhat closer together toward the discharge side. Proper support of the table has been difficult to secure. It is easily realized that if the decks are supported on rocking arms from below, as was the original plan, as the bearings wear the tables will gradually approach the lower magnet and recede from the upper one. Owing to the strong magnetic action on the steel part of the deck, the downward attraction then becomes exceedingly strong, interfering with the proper action of the table and increasing the power requirements. Sometimes the machines have become locked tight. No form of bearing could be devised to stand up satisfactorily, though many alloys were tried, but recently the tables have been suspended by flat pieces of hickory wood, somewhat after the manner of the old Empire table. This arrangement has worked perfectly and the hickory has a long life.

The concentrates going to the magnetic tables contain: Zinc, 25 to 30 per cent; iron about the same; the balance is largely sulphur, though there is 1 to 2 per cent of barite present and a small amount of gangue. The material is all through 16 mesh down to slime. The larger sizes predominate—16 to 30 mesh. The concentrates contain about 30 per cent water, and further wash water is required on the tables. Each machine will handle about 22 tons in twenty-four hours. The pyrite, and any lead and barite that is present, is not affected by the magnetic force, passing off the end of the table, as concentrate does in the ordinary form of apparatus. The sphalerite contains enough ferrous iron to be slightly magnetic, and travels downward across the riffles as tailing does on a regular table. If desired, a concentrate can be produced that will be practically pure zinc sulphide crystals, containing 56 per cent zinc, but for commercial reasons it is best to carry the zinc content at about 45 per cent. The mill will then handle a larger tonnage and less zinc will go with the pyrite, although, of course, a lower price will be received for the zinc concentrates shipped.

These machines have been in use at this plant for several years. It would seem that they would prove a practical means of separating mixed minerals whenever such minerals vary sufficiently in magnetic susceptibility, and when they are not so intimately associated as to make separation by physical means impossible at ordinary sizes. The concentrates at Edwards are fairly coarse, but good results could probably be secured on any granular material down to, say, 60 mesh. Costs at Edwards, for treatment on the magnetic tables, are now around 15c. per ton of crude ore, or about 30c. per ton of actual feed to these machines.

The following table of relative magnetic attractions is given by Edward W. Davis in "Magnetic Concentration of Iron Ore":

Relative Magnetic Attractive Force of Various Minerals

Material	Attractive Force (Iron = 100)	Material	Attractive Force (Iron = 100)
Iron	100	Apatite	0.21
Magnetite	40.18	Willemite	0.21
Franklinite	35.38	Tetrahedrite	0.21
Ilmenite	24.70	Talc	0.15
Pyrrhotite	6.69	Arsenopyrite	0.15
Siderite	1.82	Magnesite	0.15
Hematite	1.32	Chalcopyrite	0.14
Zircon	1.01	Gypsum	0.12
Limonite	0.84	Fluorite	0.11
Corundum	0.83	Zincite	0.10
Pyrolusite	0.71	Celestite	0.10
Manganite	0.52	Cinnabar	0.10
Calamine	0.51	Chalcocite	0.09
Garnet	0.40	Cuprite	0.08
Quartz	0.37	Smithsonite	0.07
Rutile	0.37	Orthoclase	0.05
Cerussite	0.30	Stibnite	0.05
Cerargyrite	0.28	Cryolite	0.05
Argentite	0.27	Enargite	0.05
Orpiment	0.24	Senarmontite	0.05
Pyrite	0.23	Galena	0.04
Sphalerite	0.23	Niccolite	0.04
Molybdenite	0.23	Calcite	0.03
Dolomite	0.22	Witherite	0.02
Bornite	0.22		

As may be noted in this table, chalcopyrite ranks far below many of the other minerals. This is not in accord with results of tests on the Weatherby tables, however, which indicate that it should be between pyrrhotite and siderite. It can easily be separated from pyrite. It is also interesting to observe that the very minerals that are so efficiently separated at the Edwards

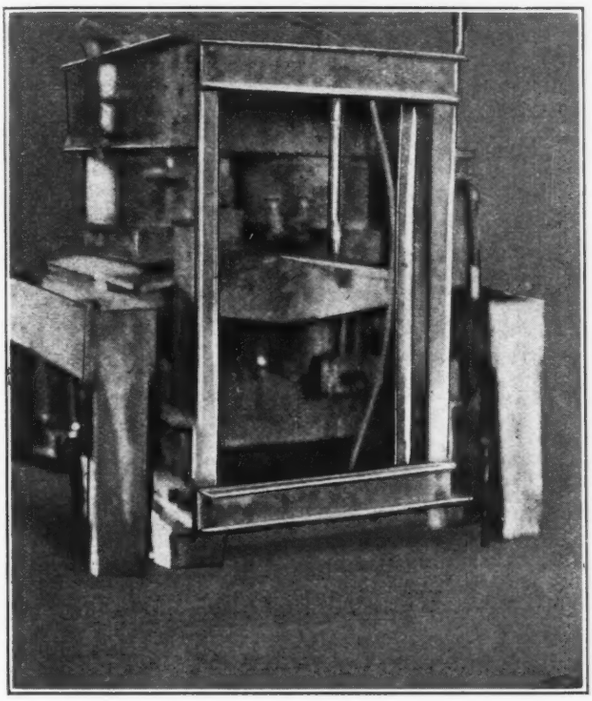


Fig. 7—A Weatherby wet magnetic table in action. A somewhat impressionistic view, owing to the vibration of the camera. The old type of deck support is used on this machine.

plant are here given as having the same magnetic attractive force. The good results on the Edwards ore are, however, caused by the fact that the sphalerite is not pure zinc sulphide, but contains considerable iron in the ferrous condition. Also, many of the other minerals given in the table on page 404 often contain sufficient iron as an impurity to cause a marked change in their attractive coefficient from that stated.

A dividing line exists, of course, between the particles of pyrite and sphalerite coming from the table; this middling is cut out, and although a part of this material is a true middling product—that is, a part consists of locked particles of the two minerals—it is sent back into the feed, gradually building up to go with either the iron or the zinc.

The zinc concentrate, being granular, is easily dewatered. It is only necessary to allow it to accumulate in steel tanks having excelsior to plug the gate in the bottom, wherefrom, after a few hours allowed for draining, it is easily removed and conveyed to the shipping bin. All of this material is shipped in closed box cars to the New Jersey Zinc Co., which finds it an excellent material from which to make zinc oxide at its Palmerton plant. The pyrite has, until the last year or two, been sold to sulphuric-acid manufacturers. Latterly it has been stocked, and arrangements are now being made to recover the zinc that it contains, which amounts to about 6 per cent.

For this purpose a high-intensity magnetic separator has been designed by Joseph Weatherby, the inventor of the magnetic tables. Its construction is illustrated in Fig. 8, though, owing to space limitations, it was not possible to include the entire machine in the photograph. Very little current is required to operate it—3 amperes at 110 volts. The magnetic force generated is so strong that it is impossible to pull away an ordinary monkey wrench held against one of the poles. The machine has a revolving steel rotator with the winding at the center and the active surfaces at each end. Opposing stationary magnets of opposite polarity act as intensifiers. High magnetic concentration is obtained by the use of threads cut on the revolving magnet rolls, the space between the threads being inlaid with copper. The machine has a capacity of 100 tons of pyrite feed in twenty-four hours, and makes a product of sufficient purity for shipment as a zinc concentrate. From results so far obtained (the separator has only just been installed), the following analyses represent the work that the machine is capable of doing on the kind of feed available: Zinc in feed, 6 to 8 per cent; zinc in zinc product, 50 per cent; zinc in pyrite product, 1 to 2 per cent; sulphur in pyrite product, 44 per cent.

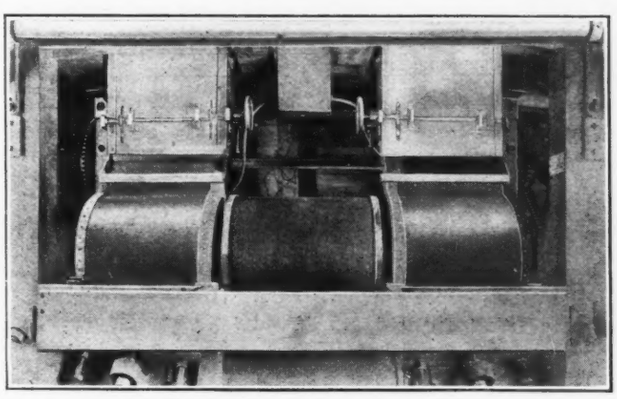


Fig. 8—Weatherby high-intensity dry magnetic separator. A new machine designed to separate the pyrite and blende in the tailing.

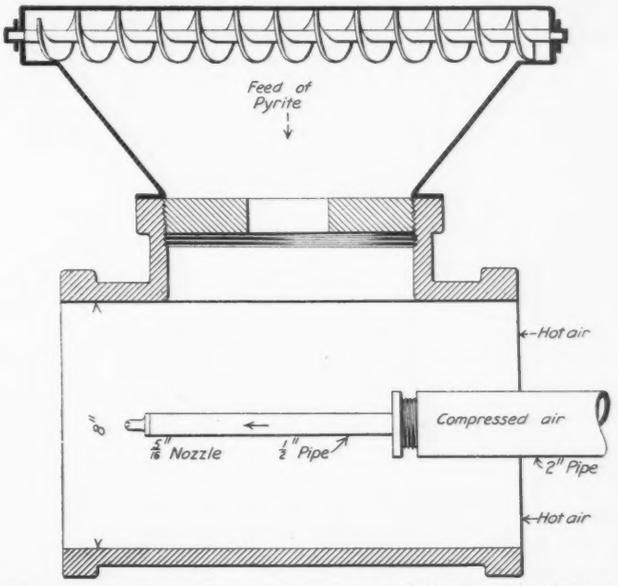


Fig. 9—Cross-section of injector and feeder for drying and transporting tailing.

Inasmuch as the pyrite concentrates on the dump are damp and the magnetic separator requires dry material, some form of drier must be used. A novel arrangement has been designed, which not only dries the concentrates but will convey them to a bin, the top of which is about 25 ft. high, from which they will be fed to the separator. This drier-conveyor is nothing but 8-in.

pipe, equipped at the feed end with a standard T in which a high-pressure air nozzle is introduced as shown in the accompanying sketch and illustration Figs. 9 and 10. Hot air is supplied by a small brick combustion chamber in which wood or coal is burned (Fig. 10). The principle of operation is the same as that of the Garr gun, used on copper converters. A sheet-iron funnel is arranged in the side opening of the T, into which the pyrite is fed by a screw conveyor after

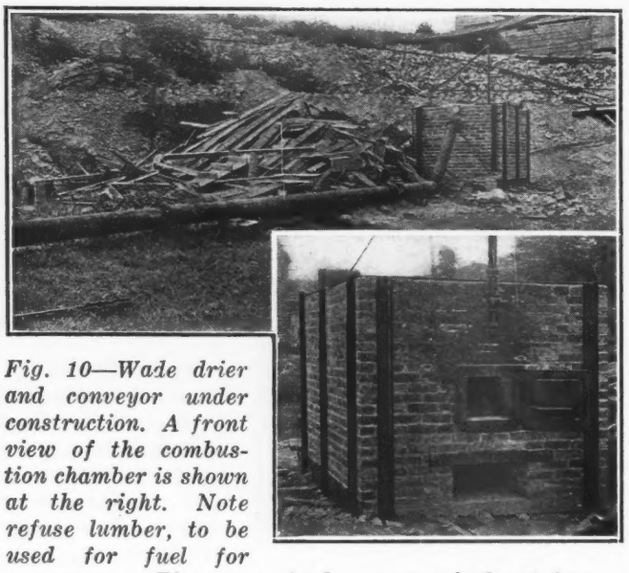


Fig. 10—Wade drier and conveyor under construction. A front view of the combustion chamber is shown at the right. Note refuse lumber, to be used for fuel for economy. The screw feed conveyor had not been installed when the photograph was taken.

being removed from the dump by a drag. The high-pressure air, which comes from the mine compressor at about 90 lb., acts as an injector, sucking the hot air from the furnace, and quickly transporting the fine material in a current of hot air to the end of the pipe, from which it is expelled in a dry and properly granular condition. The capacity of the device, which is the idea of W. R. Wade, who has applied for a patent, is 300 tons per twenty-four hours; the material being dried from a moisture content of 4 per cent to three-quarters of 1 per cent. The distance transported is 80 ft., but could be much longer without a marked decrease in efficiency. The temperature in the pipe before the introduction of the pyrite is about 700 to 900 deg. F.; at discharge end, 100 deg. This has been found to be amply sufficient to dry material of the character handled, so that the best results are secured in the magnetic separation which follows.

The following theoretical data on the Wade induced-air velocity drier has been prepared by the designer and indicates the fuel and compressed air needed, together with the cost of operation:

To dry 100 tons daily of granular pyrite from 4¼ per cent moisture to 1 per cent moisture:

Time required, eight hours.

Compressed air needed, 120 cu.ft. free air per minute at 90 lb. receiver pressure.

To compress 100 cu.ft. free air per minute requires 24 hp. Cost of power per 100 tons dried and transported, $1.70.

Coal required:

To head induced air	360 lb.
To heat jet air	90 lb.
To evaporate water	380 lb.
To heat pyrite	100 lb.
For radiation losses	300 lb.
Total per 100 tons pyrite	1,230 lb.

Cost of operation per 100 tons:

Power	$1.70
Coal at $8 per ton	4.90
One operator at $4	4.00
Cost per ton, 9.6c.	$9.60

As a result of the improvements made at this plant since the present manager, W. R. Wade, took charge in 1920, the output has been gradually increased from 960,000 lb. of zinc monthly to about 2,000,000 lb., with a material lowering of costs. With the new arrangement for the recovering of the zinc in the pyrite concentrates, the mill recovery of zinc should be about 85 per cent, compared with 70 per cent formerly. There is every indication that the Northern Ore Co. will be a producer for many years.

Elimination of Delays Due to Break-downs of Primary Importance

Although of single-unit design, the plant has operated 97 per cent of the time in the last twelve months. Break-downs are repaired instantly day or night. Ample supplies of spare parts are kept in the warehouse for all equipment. All employees receive a sliding-scale bonus based on monthly production and

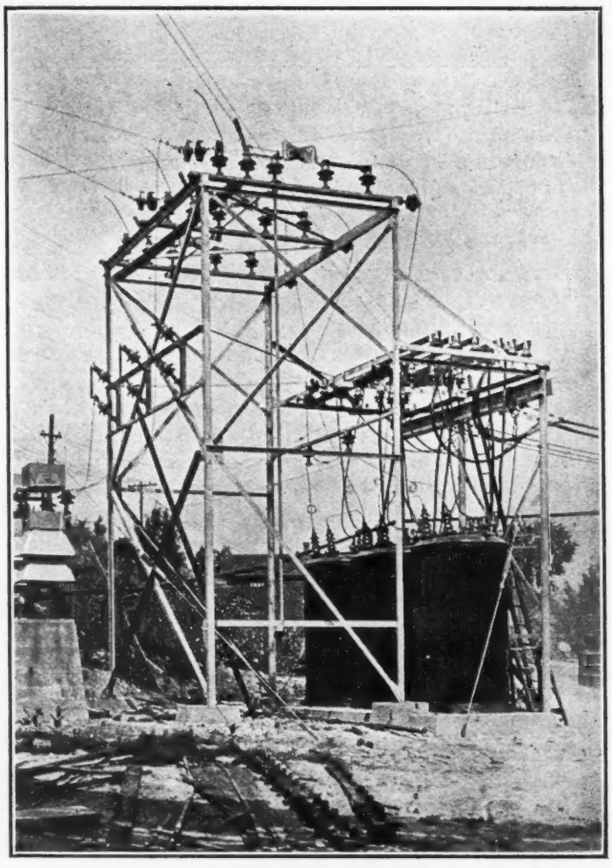


Fig. 11—Lightning arresters and transformers being installed. Capacity, 2,000 hp. Double-voltage secondaries. Power is purchased at 23,000 volts; the mine voltage is 2,400 and the mill motors use 240 volts.

the motto of the entire organization is "Never let production stop" as it affects each man's monthly bonus. As a result shirkers are automatically eliminated by their fellow workmen. Of the 3 per cent lost time in the last year, half was caused by power shortage.

A great deal of credit is accorded by Mr. Wade to S. A. Brown, mine superintendent, and O. M. Cozzens, mill superintendent, for keeping a continuous stream of ore flowing through the plant and for the many operating economies effected in their departments which have materially reduced mill costs.

The management is always looking for the most efficient equipment, and constantly making replacements to this end. Freedom from frequent need for repair is of primary importance. A machine is not considered efficient that saves a dollar a day in power but that requires an hour's shutdown of the entire mill once a week, at a direct cost of, say, $100, for the necessary repair.

Practice Improved in Many Respects

Several ingenious devices and methods of operation have been developed by Mr. Wade and his assistants, looking to a reduction of costs and the elimination of high-priced labor. Some of these will be described subsequently in the department devoted to "Useful Operating Ideas." These include a particularly satisfactory underground chute gate and method of operating it; a method of trimming roll shells; a box for settling fine concentrate; a method of priming mine pumps; an improved dirt- and moisture-proof mine-car wheel; a method of cleaning the boot and sump of a bucket elevator with a minimum of labor; a method of removing concentrates when they become hung up in a settling tank; the heat-treating of drill steel; and the salvaging of all broken parts by the oxyacetylene welding torch.

Compressor Runs Without Attendant

It is of interest that the labor cost of compressing air has been reduced to an irreducible minimum by the total elimination of all attendants from the building housing the compressor and its motor. An Ingersoll-Rand Imperial machine is used, of a theoretical capacity of 1,600 cu.ft. per minute, actually delivering about 1,400. This is belted to a 250-hp. Westinghouse synchronous motor operating at 2,400 volts. Once a day the apparatus is oiled and any necessary adjustments are made, the equipment taking care of itself the rest of the time.

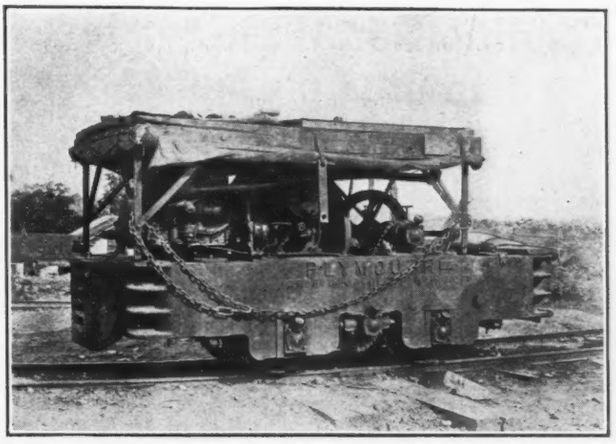
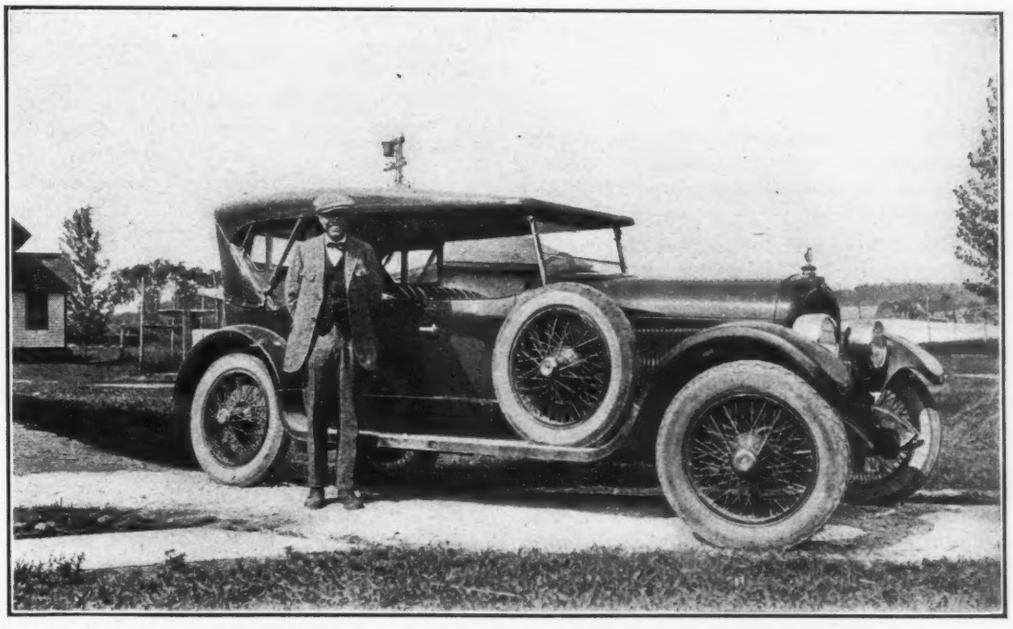


Fig. 12—This gasoline motor has been a particularly reliable machine for surface work, hauling rock to the dump, ore to the mill, and miscellaneous supplies. Gasoline is about the only item of cost—about $2 a day.

I am greatly indebted to Mr. Wade for a most enjoyable visit to his plant; and his willingness to allow a full inspection and discussion of every phase of the work, and publication of such material as seems of interest to others, is to be highly commended. It is all too rare in the zinc industry. Doubtless the point of view which Mr. Wade gained through association with the copper industry in the Southwest is responsible, for he previously served some years with the Phelps Dodge company at Nacozari.



W. R. Wade, manager of the Northern Ore Co., is an automobile enthusiast and takes pride in the ability of his new Marmon to accelerate to 60 miles per hour in a reasonable number of seconds.

Conditions in Western Mexico Invite Confidence

The Present Time Is Favorable for Reviving Old Enterprises and Starting Development

By E. P. Crawford

E. P. Crawford

THAT part of the Sierra Madre which begins in the latitude of Alamos, Sonora, and runs south along the western flanks of the Sierra Madre ranges for two or three hundred miles, embracing parts of the states of Chihuahua, Sonora, Sinaloa, and Durango, is interesting to the mining engineer historically and because of its future potential importance as a metal-mining region. During the years of the revolution it was natural that mining as well as all other industries should have suffered a severe setback. New enterprises were seldom undertaken, and only those that were functioning satisfactorily were continued. Now it has become evident that in many cases even these were operated more with an eye to immediate returns than to the future of the property; many mines that were operated almost continuously during the revolution are now closed down or being operated on a limited scale. This is due, in some cases at least, to a failure to develop the mine for future needs of the company and to maintain the plant in good repair, existing conditions making it difficult or impossible to obtain necessary supplies and replacements.

Present Production Inconsequential

At present, therefore, mining throughout this region is languishing, more so than at any time during the last twenty years. Only a few properties are producing, and new work is rare. Operations on a small scale are equally few, as evidenced by the insignificant amount of ore and bullion passing through the hands of ore buyers in the larger towns.

Some of the principal localities now idle, or nearly so, are Guazapares, Palmarejo, Rio Plata, Batopilas, Urique, Morelos, Calabacillas and Guadalupe y Calvo, in Chihuahua. Work is almost entirely suspended at the mines around Alamos and tributary regions in Sonora; in the Choix and Cosala districts, in Sinaloa, and at Topia, Sianori, and San Andres de la Sierra, in Durango. To offset this gloomy picture, a few development projects, mostly on a limited scale, have been undertaken or are now in preparation.

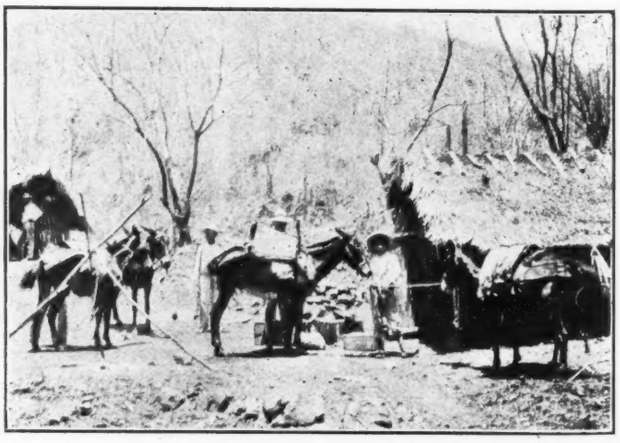
To those familiar with this section of Mexico it appears that there could scarcely be a more favorable time than the present to revive old enterprises and to undertake the development necessary to create new ones. It is true that the country is pitifully poor, and that the inhabitants have lost most of the energy and ambition they formerly possessed; thirteen years of bad times is enough to discourage the hardiest. Mexican capital does not exist, relatively speaking; and, whereas in former years local business men were able and willing to finance new discoveries and small operations, such a happening is almost unknown now. Banking facilities, in the hands of private firms, some of them having long and honorable business records, are usually limited, but in some cases excellent service is rendered, which facilitates the conduct of business enterprise.

Travel Safe, but Roads Are Poor

Politically, the country seems secure from serious trouble for a long time to come. The people have had enough of revolution. President Obregon has managed skillfully to reduce the army to a reasonable size, and to dispel the dreams of many military adventurers who had hoped to make revolution a permanent institution. There is no danger in traveling wherever one desires to go; the people are friendly, and violent crime is infrequent. The roads and pack trails are in bad repair, and good saddle and pack animals are hard to obtain, and mountain travel is arduous and slow because of difficulties of this sort.

The present inertia will be overcome only when fresh foreign capital enters Mexican mining. There is scope for a great deal of development and exploration before the number of permanently productive enterprises can be increased. Mexico at present is primarily a field for exploration and development; I do not hold the opinion that all or most of the good mines have been found. There is reasonable expectation of finding new ore deposits, as well as rejuvenating some old mines; and, as transport and smelting facilities are improved, of exploiting deposits of precious and base metals that are not now of sufficient value to be interesting. The great extent of territory that contains mineralized areas and the large number of veins and deposits already known and explored assure a long and profitable period of mining in this part of Mexico when conditions have improved. The recent re-establishment of diplomatic relations between the United States and Mexico should now encourage a resumption of promotion and development.

Pioneers will find plenty of obstacles to overcome and many discouragements, but the hope of reward and the satisfaction that comes from accomplishment will attract adventurous men, whether they risk their money or use their brains and strength to bring new supplies into the markets of the world.



At a prospect near Alamos, Sonora

New Ore of the East Mesabi Range

Some Features of the Magnetite Rock Now Being Made the Subject of Experiment — Its Genesis — Micrographs of Typical Textures

By G. M. Schwartz
Assistant Professor of Geology, University of Minnesota

AN ORE may be defined as a rock that contains a metal that can be profitably extracted. Thus a rock by new methods of treatment may become an ore, and that which was once rejected may be eagerly sought.

Recent press reports indicate that another ore should be added to the list. This is the magnetite rock of the eastern end of the Mesabi range, on which the Mesabi Iron Co., organized by D. C. Jackling and the Hayden-Stone Co., has been experimenting for the last eight years. The first mill was completed and put in operation last spring, and the management now feels that the commercial practicability of concentrating this ore has been proved. Inasmuch as there are tremendous reserves of the new ore, the importance of the event can scarcely be overestimated and the life of the Mesabi range has been greatly extended. Nor is the concentrated ore one that will be used only as other supplies are exhausted; on the contrary, it has such a high iron content (60 per cent +), and is so low in phosphorus, that it brings a considerable premium at present. The output of 300 tons per day is used by the Ford Motor Co.

The general character of the ore is of interest to many, inasmuch as the concentration represents the application of some of the methods used in treating the porphyry copper ores. It is the purpose of this article to review previous information on the occurrence, and to add something on the nature of the ore as seen under the microscope, especially on polished surfaces.

The magnetite ore being used at present is found on that part of the Mesabi range which lies east of the town of Mesaba. The pit of the Mesabi Iron Co. is located in Sec. 17, T. 60 N., R. 12 E., near Sulphur siding. The new town is known as Babbitt. This part of the range is usually known as the East Mesabi, and extends from the town of Mesaba to Birch Lake, a distance of 20 miles. It was in this area that the iron formation was first discovered, but on account of the absence of rich ores it received little attention until recently. The principal early reports that describe the area are by N. H. Winchell and H. V. Winchell,[1] Spurr,[2] Leith,[3] and Van Hise and Leith.[4] However, these reports refer primarily to the hematite deposits west of the town of Mesaba, and a report by Grout and Broderick[5] is the only one dealing primarily with the East Mesabi. The reader is referred to this report for details regarding all phases of the geology of these deposits, and the following summary is taken largely from it.

The general features of the Mesabi range as a whole have been described in the reports cited above. The East Mesabi is simply an extension of the same sedimentary series found on the main range, but, as shown in Fig. 1, the Duluth gabbro, a huge laccolithic intrusion, is close to the iron-bearing rocks along the portion extending from the town of Mesaba to Birch Lake.

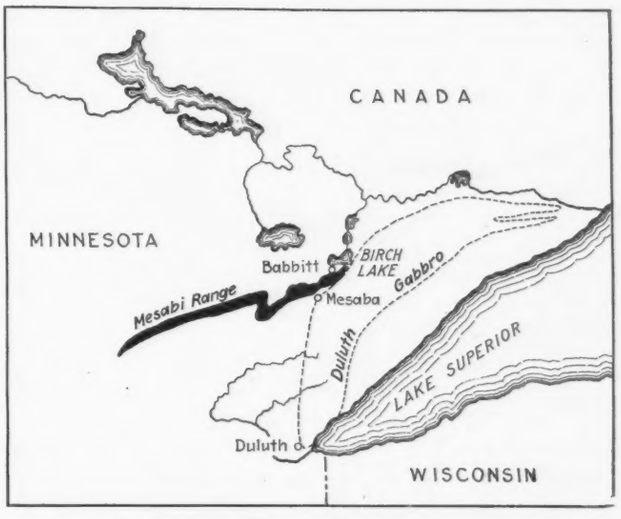


Fig. 1.—Sketch map showing Mesabi range and relation of the Duluth Gabbro to the east end

Near the gabbro the rocks are much metamorphosed and in general are recrystallized to a coarse aggregate. Farther from the contact the regional metamorphism has been intensified by the presence of the intrusive which probably once extended over the iron-bearing rocks. This metamorphism is in all probability the cause of the distinct difference in the type of deposits now found to the east and to the west of the town of Mesaba. This difference is due not so much to mineral difference as to textural variations in the rocks. The minerals of the unweathered iron-bearing rock, or taconite, in all parts of the range have been shown by Grout and Broderick,[6] and more in detail by Gruner,[7] to be principally magnetite, quartz (and chert), and amphibole, with lesser carbonate and hematite; but recrystallization at the east end has given the rock a coarser grain, eliminated any porosity, and hardened the rock so that it has been almost untouched by the weathering solutions that have formed the huge hematite orebodies of the main range. Thus magnetite remains by far the most important iron oxide in the Biwabik iron formation on the East Mesabi. The Biwabik formation is

[1] Winchell, N. H., and H. V.: "Iron Ores of Minnesota." Geol. and Nat. Hist. Surv. of Minn., Bull. No. 6, 1891.

[2] Spurr, J. E.: "The Iron-Bearing Rocks of the Mesabi Range." Geol. and Nat. Hist. Surv. of Minn., Bull. 10, 1894.

[3] Leith, C. K.: "The Mesabi Iron-Bearing District of Minnesota." U. S. Geol. Surv., Mon. 43., 1903.

[4] Van Hise, C. R. and Leith, C. K.: "The Geology of the Lake Superior Region," U. S. Geol. Surv., Mon. 52, 1911.

[5] Grout, F. F. and Broderick, T. M.: "The Magnetite Deposits of the Eastern Mesabi Range, Minnesota." Minn. Geol. Surv., Bull. 17, 1919.

[6] *Op. cit.*

[7] Gruner, J. W.: "Paragenesis of the Martite Orebodies and Magnetites of the Mesabi Range." *Econ. Geol.*, Vol. 17, 1922, pp. 1-2.

not uniform stratigraphically but has conglomerate, slate, and cherty horizons. Wolff[8] has given the details of these subdivisions, and Grout and Broderick[9] were able to correlate the horizons of the east end with those given by Wolff for the main range. Due to this stratigraphic variation, not all of the beds of the Biwabik formation are of equal value for magnetic concentration. The parts averaging between 20 and 30 per cent iron in the magnetic form are indicated in Fig. 2. The remaining beds contain from 5 to 20 per cent of iron in this form.[10] The total iron is always

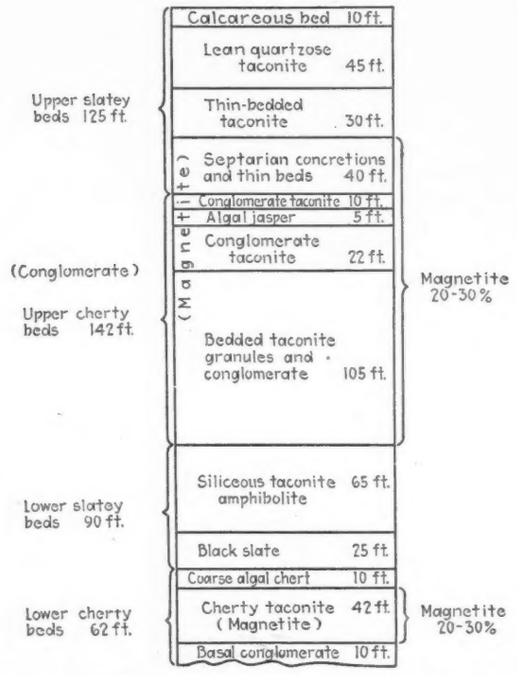

Calcareous bed 10 ft.
Lean quartzose taconite 45 ft.
Upper slatey beds 125 ft.
Thin-bedded taconite 30 ft.
(Magnetite)
Septarian concretions and thin beds 40 ft.
Conglomerate taconite 10 ft.
Algal jasper 5 ft.
Conglomerate taconite 22 ft.
(Conglomerate)
Magnetite 20-30%
Upper cherty beds 142 ft.
Bedded taconite granules and conglomerate 105 ft.
Siliceous taconite amphibolite 65 ft.
Lower slatey beds 90 ft.
Black slate 25 ft.
Coarse algal chert 10 ft.
Lower cherty beds 62 ft.
Cherty taconite (Magnetite) 42 ft.
Magnetite 20-30%
Basal conglomerate 10 ft.

Fig. 2.—Subdivisions of the Biwabik iron formation east of Mesaba. Beds containing from 20 to 30 per cent magnetite are indicated

After Grout and Broderick

higher, but part of the iron is combined with silica and other material and is not available for magnetic concentration. Much of the better ore has a pebbly texture. The generation of the magnetite during metamorphism is thought to be due to the recrystallization of mixed ferric and ferrous oxides and to the reducing effect of carbonaceous material present in the rock. In certain horizons hematite remains even where the rock has undergone considerable metamorphism.

Magnetite Principal Oxide of Biwabik Formation

The main magnetite ore horizons on the East Mesabi, as shown above, is in the middle of the Biwabik formation and is about 180 ft. thick. It consists principally of conglomeratic material (see Fig. 2). The most abundant type of ore is dark gray to black in hand specimen and contains bands with a fragmental texture and lesser bands of dense fine-grained magnetite. Some beds are composed of dense even-grained material somewhat coarser than the magnetite bands. Within a few hundred feet of the gabbro the entire mass of rock is recrystallized to a coarse-grained material, but as it dips steeply only a small amount is available near the surface.

A study of thin sections and polished surfaces of these ores reveals a large amount of but three minerals —magnetite, quartz, and amphibole. Hematite is, as a rule, not abundant, but is of particular interest because of its relation to magnetite. Quartz, amphibole, and other transparent minerals are not distinguished on polished surfaces and will be referred to collectively as gangue when describing relations on polished surfaces. The iron oxides, their texture and relationships, can best be studied on such surfaces.

Magnetite when polished is slightly grayish white as compared to hematite, which is white. This difference is not always well shown in photographs, however. The color of the powder when bits of the mineral are dug up also affords a ready means of distinguishing the two. Limonite is distinctly gray on polished surface, as compared with either magnetite or hematite.

All Magnetite in Formation Contains Gangue

An examination under the microscope quickly shows that even apparently pure magnetite is in reality made up of magnetite with more or less gangue. In specimens in which the gangue can be readily detected it usually predominates over the magnetite in a ratio of at least two to one.

The horizon which is furnishing the ore now being produced is the conglomerate of the upper cherty beds, as shown in Fig. 2, especially the two lower subdivisions. Conglomeratic and granule textures are especially characteristic of this material.

There are limited amounts of nearly pure magnetite in narrow bands and pebbles in this material. This is usually so intimately associated with the more impure phases that it cannot be mined separately, but can be easily concentrated by relatively coarse crushing and is thus a desirable constituent in the ore. As a rule the grains of magnetite are so large or so closely interlocked that only a smooth field of magnetite can be seen on a polished surface under a microscope.

Typical Textures of Conglomerate Ore

Figs. 3, 4 and 5 show micrographs of typical textures seen in the conglomerate ore now being mined. Figs. 6 and 7 are somewhat unusual phases of this same horizon and Fig. 8 is from a different horizon near the base of the Biwabik formation. Fig. 3 shows a typical intergrowth of coarse gangue in a rich magnetite ore, although a few fine grains of magnetite may be seen in the gangue. In general the grains are 1/100 of an inch in diameter or larger. Fig. 7 shows another ore of this general type—that is, a rock fairly rich in magnetite and mixed with the gangue in a fairly coarse intergrowth. A considerable percentage of the ore has the texture shown in this figure. Ore of this type does not, as a rule, show the euhedral crystals of magnetite on the polished surface. This is due to the fact that most of the grains are intergrown so that the development of crystal form has been interfered with, or, if it is developed, it is masked by the close interlocking of the grains. However, under high power it can be seen that the magnetite along the contact with the gangue shows in most places, at least, some crystal outlines. Fig. 5 shows a specimen of typical ore at a high magnification (178), in which many of the grains

[8]Wolff, J. F.: "Recent Geologic Developments on the Mesabi Iron Range." A.I.M.E., *Trans.*, Vol. 56, 1917.

[9]*Op. cit.*, Fig. 4.

[10]See Grout and Broderick. *Op. cit.*, pp. 16 and 17 for details.

Fig. 3.—Micrograph of a polished surface of rich conglomeratic ore

Note that the magnetite, M, and the gangue, G, occur as a fairly coarse intergrowth. Specimen from the quarry of the Mesabi Iron Co., Sec. 17, T. 60 N., R. 12 W. Mag. X67.

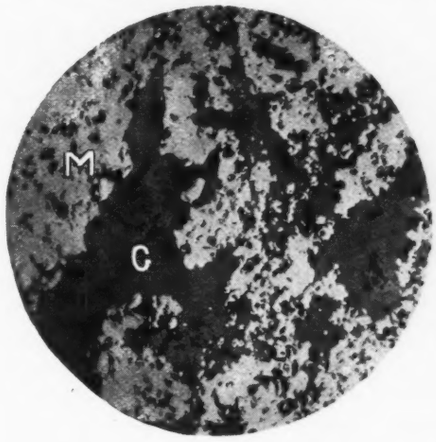


Fig. 5.—Micrograph of the same specimen as Fig. 4

Shows the crystal outline of many of the magnetite grains. This can be seen best along the gangue, G. Most of the magnetite is crystallized in this manner. Mag. X178.

have crystal outlines. In general it is probable that most of the magnetite exists as aggregates of crystals, which gives the rock a fine granular texture.

Not all the magnetite occurs as the relatively coarse intergrowths described above—that is, as grains 1/100 of an inch or more in diameter. Fig. 4 shows a fine band or ore from the same location as that from which Fig. 3 was taken. In this case the magnetite is present as grains which average perhaps 1/500 of an inch across.[11] Bands of this ore are abundant and are intimately associated with the coarser bands, thus making it impossible to eliminate all of the fine-textured material during the process of mining or later by cobbing. In fact, the types are so intimately mixed that Figs. 3 and 4 might be obtained from the same specimen. There are all gradations between the types illustrated by Figs. 3 and 4.

Some bands of lean ore in the conglomerate horizon (see Fig. 6) show rounded granules of hematite with a few irregular areas of magnetite. Some of the rounded granules are only outlined by a few hematite grains. This rock, in all probability, represents the original greenalite rock which was described in detail by Leith, in connection with the hematite deposits of the main range. This texture is found well preserved only in certain limited horizons. The fact that the magnetite grains in this specimen are irregular suggests that the rather perfect form shown by the hematite granules is destroyed by recrystallization.

Fig. 7 shows an odd combination found in rich magnetite rock in rare cases. The large, light-gray areas are magnetite and the dark-gray areas are gangue. Distributed through the gangue are small white grains, which are hematite. Why the hematite remains in the gangue, whereas the large grains have been turned to magnetite, is a question not easily answered. Possibly the gangue protected the small grains in some way, so that they escaped the partial reduction which results in magnetite, or possibly the small grains oxidized, while the larger grains did not.

It is, of course, inconceivable that the magnetite was deposited as such, and the development of crystals pro-

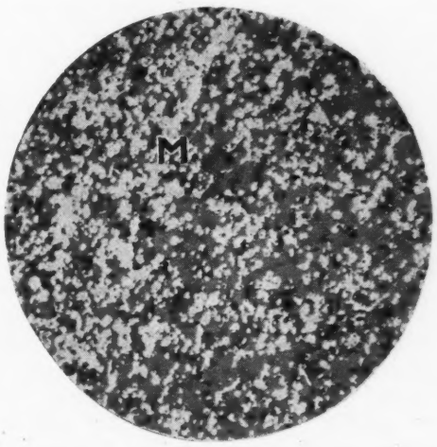


Fig. 4.—Micrograph of a polished surface of a fine-grained phase of conglomeratic ore

The white grains are magnetite; the gray is gangue, principally quartz. Note the band at M. This is the bedding. Most of the grains in this figure are about 1/500 of an inch in diameter. From exploration of Mesabi Iron Co. Sec. 17, T. 60 N., R. 12 W. Mag. X67.

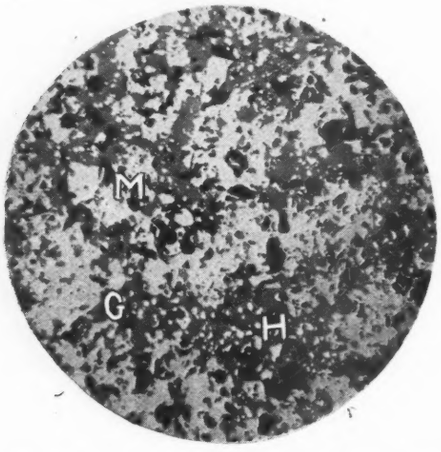
Fig. 6.—Micrograph of a lean ore, largely hematite

The round grains are probably pseudomorphs after greenalitic granules. Note that some are only outlined by hematite grains. The black spots are holes caused by grains breaking out during polishing. The gangue, G, is gray. The irregular area, M, is magnetite. From the upper cherty horizon, near Babbitt. Sec 17, T. 60 N., R. 12 W. Mag. X67.

[11]See also Gruner, J. W.: *Op. cit.*, Plate 1 Fig. *c*.

Fig. 7.—Micrograph of an ore which is dense and even-grained in hand specimen

Under the microscopic magnetite, M, is seen as medium-sized grains. The small white grains in the dark gray gangue are hematite, H. From the upper algal horizon near Babbitt. Mag. X140



jecting into the gangue is an evidence of its late development by crystallization. In certain horizons hematite persists to a large extent, as shown in Figs. 7 and 8. In other horizons the change to magnetite is almost complete, as illustrated in Fig. 7, and in the main body of ore only magnetite is found (Figs. 3, 4, and 5).

Order of Formation of Iron Oxides Indicated in One Micrograph

Fig. 8 throws some light on the general order of the formation of the iron oxides. The picture is from a conglomerate with many algal structures from near the base of the Biwabik formation. In the hand specimen, the iron oxide is largely hematite, although some of the larger pebbles are magnetite. Under high magnification euhedral crystals of magnetite can be seen in the hematite. Euhedral crystals of this sort are usually developed at a late stage by replacement or recrystallization. In this case it is probable that the magnetite has developed from the hematite, as the blade-like crystals of hematite can be seen to end abruptly at the contact with magnetite as if cut off by it.[12]

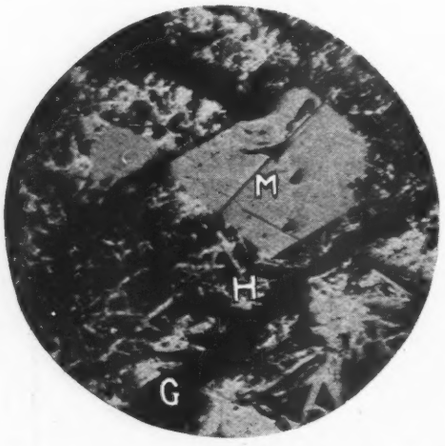


Fig. 8.—Micrograph showing an euhedral crystal of magnetite, M, in hematite, H, and gangue, G

Euhedral grains of this sort are usually of late development, and this is indicated here by the fact that the hematite needles are cut off sharply at the contact with the magnetite.. From the algal conglomerate phase. N. E. ¼ Sec. 15, T. 59 N., R. 14 W. Mag. X300.

[12]Gruner, J. W.: *Op. cit.*, p. 7.

The most conclusive evidence that the magnetite formed from hematite is shown in Fig. 9. This is taken from a specimen similar to that shown in Fig. 6—that is, magnetite and hematite in rounded aggregates apparently pseudomorphous after greenalite granules. In Fig. 9 a group of crystals with the form of hematite are shown, but the crystals are now entirely magnetite. They are pseudomorphs of magnetite after hematite.[13]

The field evidence indicates that the magnetite developed from hematite, and this is substantiated by microscopic evidence of the sort that has been described above.

The above set forth descriptions and figures indicate some of the features of the ore and its genesis. Some of the problems of concentration may be inferred from the texture of the ore. Fortunately, a considerable part of the ore is of the coarse type shown in Fig. 3 and also much coarser, but that some of it is exceedingly fine is shown in Fig. 4. This fine material is apparently not a bar to successful concentration, as the total extraction is from 80 to 86 per cent of the magnetite originally contained in the ore, giving a product assaying from 62 to 65 per cent iron.

Fig. 9.—Micrograph showing crystals, with the form of specular hematite, which are now magnetite

Similar crystals in the same specimen remain hematite. These pseudomorphs of magnetite after hematite show that much of the magnetite of the East Mesabi developed from hematite. From S. E. ¼, Sec. 32, T. 60 N., R. 13 W. Mag. X200.

Concentration Possible Because Iron Exists in Magnetic State

The concentration of iron ore has not been a large industry in the United States in the past, owing to the existence of abundant and easily mined high-grade deposits. Furthermore, the concentration of hematite ore is beset with many difficulties. The fact that low-grade ore of the type described can be concentrated is directly due to the existence of the iron in the magnetic state. If the same type of rock contained hematite it would undoubtedly be generations before it would be of value. In any event, the successful treatment of the fine-grained and exceedingly hard taconite of the East Mesabi is an accomplishment that is of no mean proportions.

[13]Gruner, J. W.: *Op. cit.*, plate II.

Ventilation Problems

A Discussion of Various Factors in the Operation of Fans

By Walter S. Weeks
University of California, Berkeley, Calif.

IN PREVIOUS ARTICLES[1] I discussed the construction of fan characteristics and showed how certain problems in the use of fans are solved. In this article I shall continue with other problems involving the fan that are equally important. I shall assume that the reader has mastered the theory of the fan and duct characteristics and knows the fan laws stated.

Let us first consider the effect of air density on fan operation. The weight of a cubic foot of air, which is the unit of density used, varies with the temperature of the air, the barometric pressure, and the humidity. By permission of the Buffalo Forge Co. I am permitted to use the accompanying table for determining the density of air. A study of this useful table shows that the weight of air increases with increase of pressure, decreases with increase of temperature, and decreases with increase of moisture content.

The performance tables used by the fan manufacturers and the fan characteristic curves supplied with a fan are based upon a standard density of air of about 0.075 lb. per cu.ft. Now, if the fan is to be used under conditions where the air is not at standard density, then the tables or characteristics no longer apply without corrections. The corrections are based upon the following simple rule: For a given quantity and speed the pressure produced by a fan and the horsepower necessary to run the fan vary directly with the density of the air. For example: Suppose that a fan running at a given speed can deliver 10,000 cu.ft. per minute at a 3-in. water gage with a power consumption of 8 hp. when the density is 0.075. What would be the water gage and horsepower if the density were 0.065?

The ratio of the new density to the old is $\frac{0.065}{0.075}=0.87$.

With the fan running at the same speed and delivering 10,000 cu.ft. at a density of 0.065, the water gage and horsepower would be as follows:

Water gage $0.87 \times 3 = 2.61$.

Horsepower $0.87 \times 8 = 6.96$.

So if we have a characteristic curve for a given speed and density, we may construct characteristics at the same speed and for other densities by selecting points on the given characteristic, multiplying the water-gage reading by the ratio of the new density to the old and plotting the new pressures on the same quantity lines.

Curve *A*, Fig. 1, is a characteristic curve at the standard density. Curve *B* is a curve plotted from it for an altitude where the density is 0.05. When the fan is used at this altitude, curve *B* is the characteristic of the fan for use in all calculations.

After a certain type of fan has been perfected by a manufacturer different sizes are then built. If a characteristic for one size at a given speed is known, then the characteristic for a similar fan of another size may be plotted. By "similar fan" is meant one in which all essential linear dimensions are a given multiple of the first. The method of constructing the characteristic of the similar fan may best be illustrated by an example. Suppose that curve *A*, Fig. 2, is the characteristic of a fan with a fan wheel 30 in. in diameter, running at 750 r.p.m. and that we want the characteristic of a similar fan with a wheel diameter of 60 in.

The fan law that we use is this: With the same linear velocity of the blade tips, the pressure supplied by two similar fans will be the same when the quantity given by the larger is to the quantity given by the smaller as the square of the wheel diameter of the larger is to the square of the wheel diameter of the smaller.

We now select a point on characteristic curve *A*, Fig. 2, and multiply the quantity by the square of the ratio of wheel diameters, which in this case is 4, and plot the new point with this new quantity and the same pressure. For example, the point *y* on curve *B* is obtained from the point *x* on curve *A*. By plotting a sufficient number of points we obtain curve *B*, which is a characteristic of the larger fan running with the same tip speed. If the tip speed is the same, the revo-

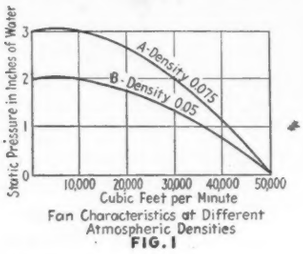
[1] "Selection of Fans for Pipe Ventilation," *Journal-Press*, May 13, 1922; and "Useful Fan Calculations," *Journal-Press*, April 14, 1923.

Weights of Saturated and Partly Saturated Air for Various Barometric and Hygrometric Conditions—Lb. per Cu.Ft.

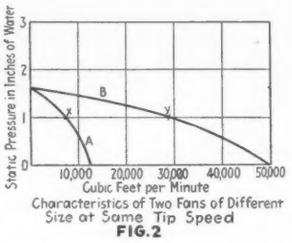
Dry Bulb Temperature, Degrees Fahr.	Barometric Pressure—Inches															Approx. Aver'g Increase in Weight per Deg. Wet Bulb Depression
	26			27			28			29			30			
	Wt. per Cu.Ft. Saturated Air	Decrease Wt. per Deg. Inc. Dry Bulb	Increase Wt. per 0.1 In. Rise in Bar.	Wt. per Cu.Ft. Saturated Air	Decrease Wt. per Deg. Inc. Dry Bulb	Increase Wt. per 0.1 In. Rise in Bar.	Wt. per Cu.Ft. Saturated Air	Decrease Wt. per Deg. Inc. Dry Bulb	Increase Wt. per 0.1 In. Rise in Bar.	Wt. per Cu.Ft. Saturated Air	Decrease Wt. per Deg. Inc. Dry Bulb	Increase Wt. per 0.1 In. Rise in Bar.	Wt. per Cu.Ft. Saturated Air	Decrease Wt. per Deg. Inc. Dry Bulb	Increase Wt. per 0.1 In. Rise in Bar.	
0	0.07500	0.00016	0.00029	0.07788	0.00016	0.00029	0.08077	0.00017	0.00029	0.08365	0.00018	0.00029	0.08654	0.00019	0.00029	0.000015
10	0.07338	0.00016	0.00028	0.07620	0.00016	0.00028	0.07903	0.00017	0.00028	0.08185	0.00018	0.00028	0.08468	0.00018	0.00028	0.000016
20	0.07180	0.00016	0.00028	0.07456	0.00016	0.00028	0.07733	0.00017	0.00028	0.08009	0.00018	0.00028	0.08286	0.00018	0.00028	0.000017
30	0.07027	0.00015	0.00027	0.07297	0.00016	0.00027	0.07569	0.00016	0.00027	0.07839	0.00017	0.00027	0.08110	0.00017	0.00027	0.000019
40	0.06879	0.00015	0.00026	0.07143	0.00015	0.00027	0.07409	0.00016	0.00027	0.07675	0.00016	0.00027	0.07942	0.00017	0.00027	0.000021
50	0.06732	0.00015	0.00026	0.06992	0.00015	0.00026	0.07252	0.00016	0.00026	0.07512	0.00016	0.00026	0.07773	0.00016	0.00026	0.000023
60	0.06588	0.00015	0.00026	0.06843	0.00015	0.00026	0.07098	0.00015	0.00026	0.07353	0.00016	0.00026	0.07609	0.00016	0.00026	0.000026
70	0.06442	0.00015	0.00025	0.06692	0.00015	0.00025	0.06943	0.00015	0.00025	0.07193	0.00016	0.00025	0.07440	0.00016	0.00025	0.000029
80	0.06297	0.00015	0.00025	0.06542	0.00015	0.00025	0.06789	0.00015	0.00025	0.07034	0.00015	0.00025	0.07280	0.00016	0.00025	0.000034
90	0.06146	0.00015	0.00024	0.06388	0.00016	0.00024	0.06629	0.00016	0.00024	0.06870	0.00016	0.00024	0.07112	0.00017	0.00024	0.000039
100	0.05991	0.00016	0.00024	0.06228	0.00016	0.00024	0.06465	0.00016	0.00024	0.06703	0.00017	0.00024	0.06939	0.00018	0.00024	0.000044
110	0.05828	0.00016	0.00023	0.06060	0.00017	0.00023	0.06293	0.00017	0.00023	0.06526	0.00018	0.00023	0.06759	0.00019	0.00023	0.000051
120	0.05653	0.00018	0.00023	0.05882	0.00018	0.00023	0.06111	0.00018	0.00023	0.06339	0.00019	0.00023	0.06569	0.00020	0.00023	0.000059
130	0.05467	0.00019	0.00023	0.05692	0.00019	0.00023	0.05917	0.00019	0.00023	0.06142	0.00020	0.00023	0.06367	0.00022	0.00023	0.000068
140	0.05262	0.00021	0.00022	0.05483	0.00021	0.00022	0.05704	0.00021	0.00022	0.05925	0.00022	0.00022	0.06147	0.00024	0.00022	0.000078
150	0.05036	0.00023	0.00022	0.05253	0.00023	0.00022	0.05471	0.00023	0.00022	0.05689	0.00024	0.00022	0.05906	0.00026	0.00022	0.000090
160	0.04788	0.00025	0.00022	0.05001	0.00025	0.00022	0.05216	0.00026	0.00021	0.05430	0.00026	0.00021	0.05644	0.00029	0.00021	0.000103
170	0.04509	0.00028	0.00021	0.04720	0.00028	0.00021	0.04931	0.00029	0.00021	0.05141	0.00031	0.00021	0.05352	0.00033	0.00021	0.000118
180	0.04197	0.00031	0.00021	0.04404	0.00031	0.00021	0.04611	0.00032	0.00021	0.04818	0.00034	0.00021	0.05026	0.00036	0.00021	0.000134
190	0.03845	0.00035	0.00021	0.04049	0.00036	0.00021	0.04253	0.00036	0.00021	0.04457	0.00037	0.00021	0.04662	0.00038	0.00021	0.000153
200	0.03449	0.00040	0.00020	0.03650	0.00040	0.00020	0.03851	0.00040	0.00020	0.04052	0.00041	0.00020	0.04254	0.00041	0.00020	0.000173

lutions per minute of the big fan must be one-half the revolutions per minute of the small fan; so we have, then, in curve *B* a characteristic of the large fan at 375 r.p.m. From this characteristic others at different speeds may be constructed. The horsepowers also vary as the square of the size ratio. The horsepower at *y* is four times the horsepower at *x*.

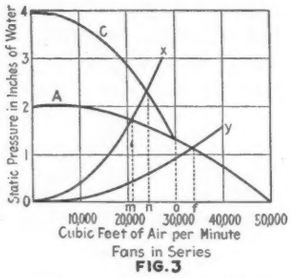
The use of fans in series is justifiable under certain conditions. The operator should know exactly what the result will be when fans are so placed, for if two fans of different sizes are placed in series the smaller fan may act only as a hindrance to the operation of the larger. Let us suppose that we have two fans which, running at certain speeds, will have the characteristics *A*, Fig. 3 and *B*, Fig. 4. We wish to place these two fans in series on a certain mine.



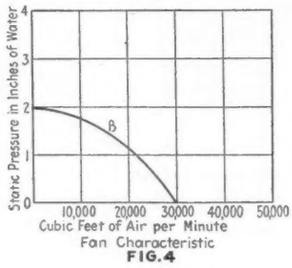
Fan Characteristics at Different Atmospheric Densities
FIG. 1



Characteristics of Two Fans of Different Size at Same Tip Speed
FIG. 2



Fans in Series
FIG. 3



Fan Characteristic
FIG. 4

Fan characteristics under various conditions

Plot the characteristic of the smaller fan on top of the characteristic of the larger fan. This is done by adding the water-gage readings of the two fans at the same quantities. Curve *C*, Fig. 3, shows the combined characteristic. This curve *C* may now be treated as the characteristic of a single fan. When these fans in series are placed on a mine, the quantity of air that will flow through the mine will be determined by the crossing of the mine characteristic and the combined fan characteristic.

By "mine characteristic" is meant the curve that shows the pressure necessary to force different quantities of air through the mine. The mine characteristic is obtained in this manner: Determine the water gage on the mine with some quantity assumed. The method of doing this is explained in previous articles.[2]

Now, using the principle that the water-gage reading is proportional to the square of the quantity circulating, assume different quantities and calculate the water gage necessary to force these quantities through the mine. From these results the "mine characteristic" may be plotted.

To return to our problem of fans in series, let *x*. Fig. 3, be a mine characteristic. If the big fan alone is operating, the quantity *m* will flow. If the two are operating in series, the quantity *n* will flow.

If, however, the mine has a lower resistance and *y* is its characteristic, it will be seen that the small fan is a positive disadvantage, because the small fan when producing no external pressure at all cannot force more than the quantity *o* through its own vanes.

If the big fan is operating alone on the *y* mine the quantity *f* will flow. If the two are in series on this mine, less than this will flow, because the big fan must force the air through the small fan.

It makes no difference, so far as the amount of air circulated is concerned, whether the fans in series are all at one place, with one discharging into the inlet of the other, or whether they are strung out after the manner of the so-called "booster" fans. In the first case the initial pressure is higher and leakage is accentuated. If the duct is tight, the first method is usually preferable. The combined characteristic of any number of fans in series may be had in the same way.

If we have a duct of low resistance it may be better to place the fans in parallel instead of in series. Let us see what the result would be if we placed these same fans in parallel, first on the mine *x* and then on the mine *y*, Fig. 3. Both fans must be producing the same pressure. This pressure will be some pressure on the mine characteristic. Assume an air quantity through mine *x* and read the pressure from curve *x* necessary to force this quantity through the mine. Now, from the two fan characteristics, *A*, Fig. 3 and *B*, Fig. 4, determine what quantity each fan will deliver at this pressure. If the sum of these two quantities does not equal the assumed quantity, continue this operation until it does. This will be the quantity that will flow. The division of the load will have been determined and horsepowers may be computed.

If these calculations are made on mines *x* and *y* we reach the following conclusions:

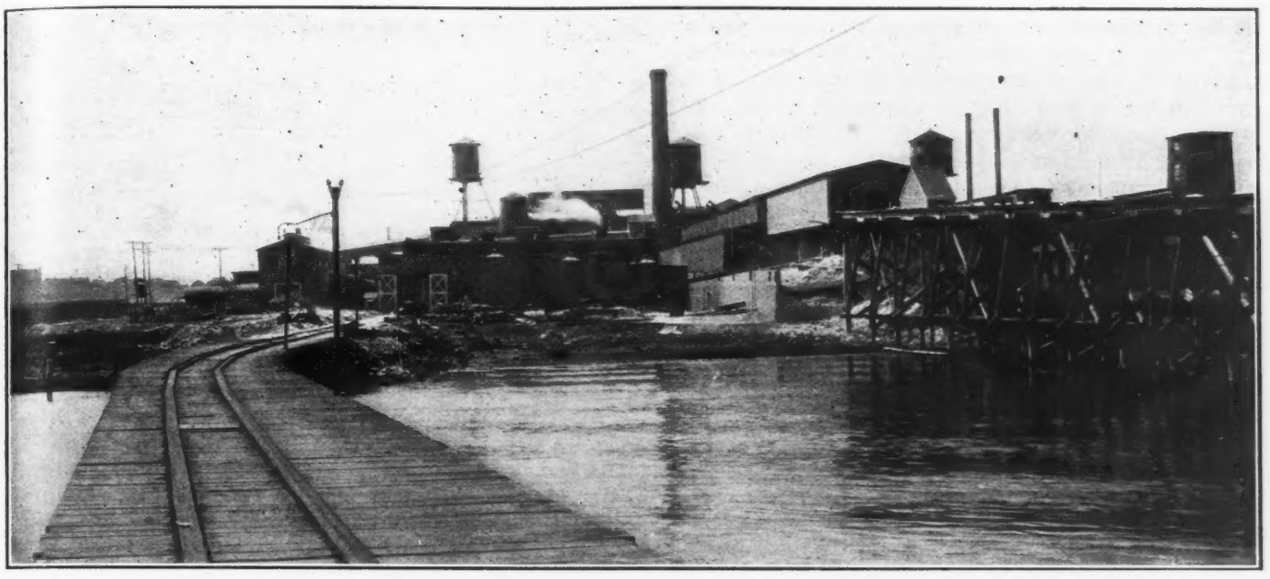
On mine *x* the big fan alone will circulate 21,000 cu.ft., the two fans in series will circulate a little more than 24,000 cu.ft., and the two fans in parallel will circulate about 22,000 cu.ft.

On mine *y* the big fan will circulate a little less than 34,000 cu.ft., the two fans in series will circulate less than this amount, and the two in parallel about 39,500 cu.ft.

Fans in parallel are very tempermental, and the operator may find that instead of the fans working together amicably and each sharing its part of the burden, one fan may blow the air out of the inlet of the other. This happens when the fans are working on the high portion of the characteristic. To operate well, the fans should be operating on the sloping part of the characteristic. Then if momentarily one fan produces a higher pressure than the other, the flow of air is decreased from the other, its pressure rises and it picks up its load. If, however, the fans are operating on the flat part of the characteristic, a decrease of air in the fan will cause little increase of pressure, so whichever fan "gets the jump" on the other will force air back through the other fan.

The two fans we have been discussing would probably not work in parallel on mine *x*. They probably would operate successfully on mine *y*. So we may conclude that a high mine resistance usually favors the operation of fans in series and a low mine resistance favors fans in parallel, because with a high mine resistance the fans in parallel will probably be operating on the flat part of the characteristic, whereas with a low mine resistance they will probably be operating on the steep part of the characteristic.

[2] "The Friction of Ventilating Currents," by Walter S. Weeks, *Mining and Scientific Press*, April 24, 1920; and "Testing and Application of Ventilating Fans," by Walter S. Weeks, *Mining and Scientific Press*, July 24, 1920.



The Benjamin Moore plant as seen from the pier where the chalk barges are unloaded

Dressing Crude Chalk by Modern Methods

At Carteret, N. J., the Benjamin Moore Co. Cut Its Cost 50 Per Cent by Re-equipping Its Old Plant With Up-to-date Machinery

By Arthur B. Parsons
Assistant Editor

THREE YEARS AGO the Benjamin Moore Co. normally employed thirty-eight men and a woman in the whiting department of its plant at Carteret, N. J. Today, as a consequence of modernizing the operations, nine men of no higher grade of skill and intelligence do the same work — namely, to unload, grind, de-sand, filter, and dry approximately five tons of raw material per hour. This material as it arrives at the company's wharf on barges is crude French chalk containing about 20 per cent moisture. The finished product after the water and 8 per cent of sand is removed is a pure-white gritless whiting containing particles ranging in size from 300 mesh to an impalpable powder. Its moisture content ranges between 0.4 and 0.7 per cent. A ton of chalk produces about 0.72 tons of whiting.

In addition to cutting the labor cost to about 42 per cent, the cost of fuel has been decreased somewhat. On the other hand, power requirements have been increased by 70 kw., plant maintenance is slightly higher, and the interest charges on the investment are higher, on account of the installation of costly equipment. Most of the new machinery was placed in the old building and a great deal of space is unoccupied. If a new plant were designed to suit the needs of the process now used, a smaller and less costly building would suffice.

MUCH of the equipment used in this plant is being used, or could be used, advantageously in the dressing of such non-metallic minerals as barytes, feldspar, ochre, talc, kaolin, slate, silica and soapstone. Producers of these minerals should find the article of special interest. The Benjamin Moore Co. effected marked economy by rebuilding its old plant. The greatest saving is in the labor required for operation and maintenance.

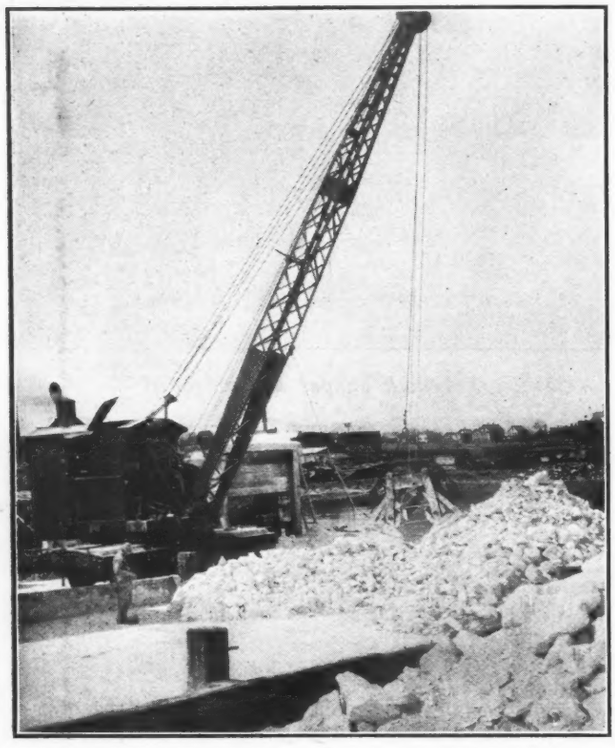
The net result of the operation of the present remodeled plant, for which H. I. Haskins, resident manager for the Benjamin Moore Co., is responsible, is to increase the capacity of the plant and cut the cost of producing whiting by the old method approximately in two. Moreover, because of efficient separation, a much larger proportion of the chalk is turned out in the form of the more valuable of two finished products made. This is an important feature.

A graphic presentation of the principal changes is shown in the table appearing on page 416. The table indicates a greater reduction in labor than I have mentioned. It should be explained that this is for direct operating only, whereas the cost of labor for upkeep is somewhat higher with the present equipment.

Except to contrast some features of the old procedure with those of the new, little need be said about the former method. The separation of the sand was effected by passing the pulp through a series of slightly sloping troughs 12 ft. long in which the current, being slow, allowed the sand to settle. Men with square-nosed shovels dug out the settled material and trucked it to a boiler-flue drier. The overflow from the sand vats passed through a series of five vats each measuring 10x6x6 ft. The whiting that collected in the first vat

was not sufficiently fine to pass as first-class product, but formed an intermediate grade. The process was intermittent, and at intervals the settled whiting was stirred in the tanks by hand and pumped to the filters. By the present process only two products are made: the sand and the highest grade whiting.

The filtering was formerly done in four 40-frame,



Unloading chalk from the barge by means of a grab bucket

24x24-in. plate-and-frame pressure filters. Seven men cleaned presses in rotation and one woman prepared canvas cloths with which to cover the frames.

Mute testimony as to the apparent inefficiency of drying is borne by the hundreds of racks and the thousands of feet of steam coils that occupy the upper floor of the plant, to which the cakes from the filters were elevated in small-car lots.

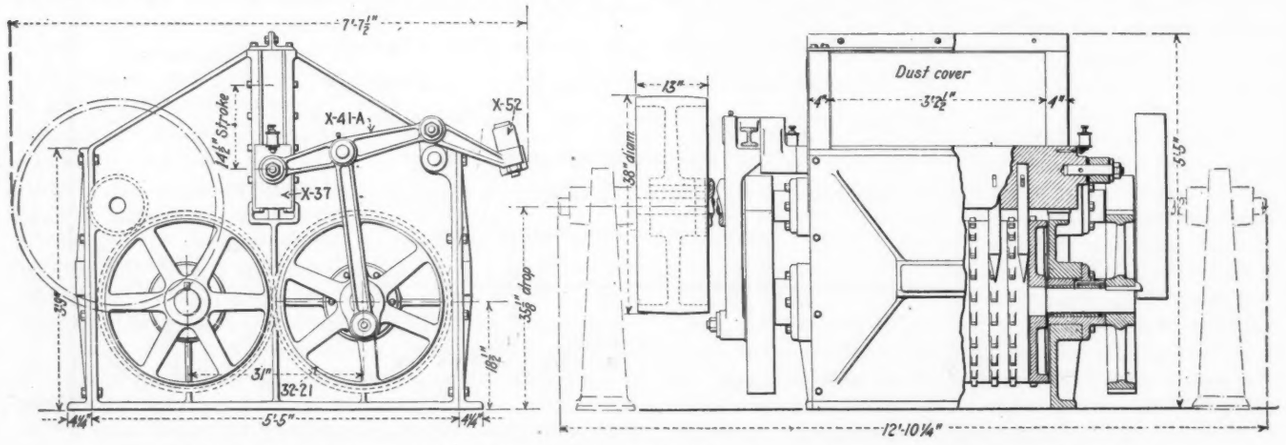
On the face of it this method of drying seems to be an inexcusably inefficient procedure. In explanation in part it may be said that it had always been thought that "air" drying was necessary to obtain a satisfactory product. As a matter of fact Mr. Haskins has been trying for a year to find any test under which his "furnace" dried product will fail to give as good or better results than material dried in the old steam racks. If there were one he thinks he would have found it before now. It is true that the drying presents some unusual problems, but these have all been solved satisfactorily, as will appear later.

Comparison of Old and New Procedures

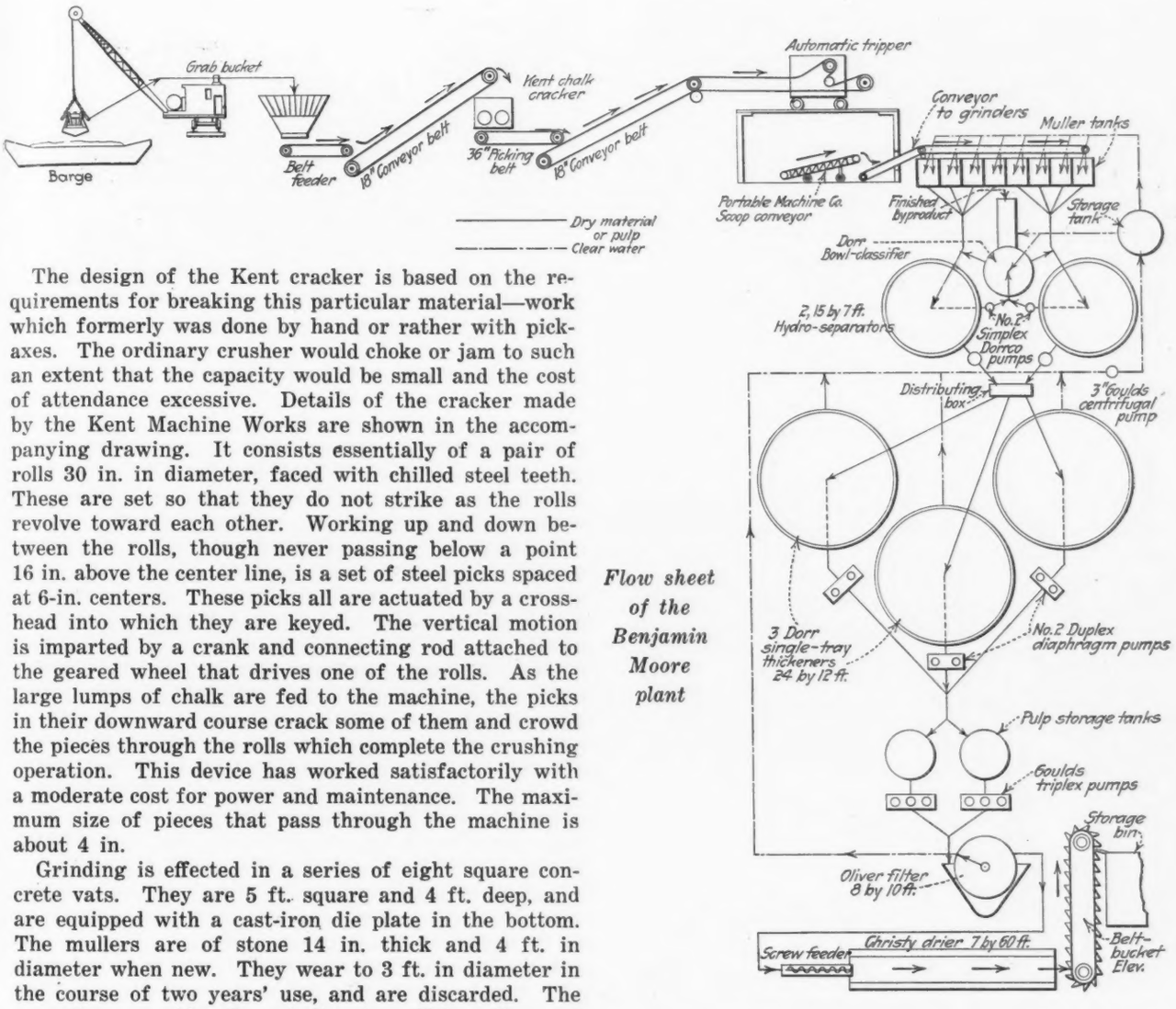
Number of Men	Old Method	Operation	New Method	Number of Men
10	Shoveled by hand into a bucket operated by a crane	Unloading from barge	Orton and Steinbrenner grab buckets	4
	Cars	Transportation to crude storage bin	Robins conveying system	
3	Men with pickaxes	Coarse crushing	Kent "cracker"	0
7	Cablecar and shoveling by hand	Transportation to grinders	Robins conveying system	3
		Grinding—No change		
3	Shoveling sand out of troughs	De-sanding	Dorr classifier and hydroseparator	0
	Rectangular vats	Settling	Dorr thickeners	
8	"Plate" filters (one seamstress)	Filtering	Oliver filter	1
5	Hauling filter cakes to and from steam racks	Drying	Christie drier	1
2	Trucking	Transporting to factory	Robins conveying system	0

The flow sheet on page 417 gives a comparatively complete picture of the progress of the material through the various stages of treatment. There are some points, however, that are of peculiar interest to those who have comparable problems; to these it may be worth while to draw special attention. As this article is intended primarily for those whom we classify as nonmetallic operators, who are not generally familiar with the equipment that is used, I shall describe it in a more detailed and elementary way than would be justified if they were well acquainted with the machines involved.

The crude chalk as it arrives at the plant is a difficult material to handle. It is essentially calcium carbonate in amorphous form and contains 20 per cent moisture. The bulk chalk, especially when loaded in the rain or when it has been carried in a leaky ship, can be consolidated by pressure. For this reason it would be impracticable to unload into a large bin provided with a feeder of any of the ordinary types. Instead, the barge is unloaded by means of a grab bucket only as rapidly as the crusher or cracker, as it is called, can handle the crude chalk.



Details of the chalk crackers, showing the teeth that force the material between the rolls



Flow sheet of the Benjamin Moore plant

The design of the Kent cracker is based on the requirements for breaking this particular material—work which formerly was done by hand or rather with pick-axes. The ordinary crusher would choke or jam to such an extent that the capacity would be small and the cost of attendance excessive. Details of the cracker made by the Kent Machine Works are shown in the accompanying drawing. It consists essentially of a pair of rolls 30 in. in diameter, faced with chilled steel teeth. These are set so that they do not strike as the rolls revolve toward each other. Working up and down between the rolls, though never passing below a point 16 in. above the center line, is a set of steel picks spaced at 6-in. centers. These picks all are actuated by a crosshead into which they are keyed. The vertical motion is imparted by a crank and connecting rod attached to the geared wheel that drives one of the rolls. As the large lumps of chalk are fed to the machine, the picks in their downward course crack some of them and crowd the pieces through the rolls which complete the crushing operation. This device has worked satisfactorily with a moderate cost for power and maintenance. The maximum size of pieces that pass through the machine is about 4 in.

Grinding is effected in a series of eight square concrete vats. They are 5 ft. square and 4 ft. deep, and are equipped with a cast-iron die plate in the bottom. The mullers are of stone 14 in. thick and 4 ft. in diameter when new. They wear to 3 ft. in diameter in the course of two years' use, and are discarded. The operation resembles the grinding in a Chile mill except that there is only one muller in each vat and the vats are kept nearly full, the ground material passing out near the top as a thin sludge with the consistency of about 11 parts water to 1 part of solid. The central vertical shaft on which the muller shaft is hinged revolves at 5 r.p.m. One vat is emptied each week so that the accumulated sand and flint can be shoveled out. A representative screen analysis of the discharge follows:

Mesh	Per Cent	Mesh	Per Cent
+ 10	.....	+200	2.50
+ 35	.....	+300	2.70
+ 65	.....	+325	4.10
+100	Trace	—325	90.20
+150	0.57		

The object in the next step is to separate the grit in this overflow from the impalpable chalk; the fine finished product should contain a minimum proportion of material coarser than 300-mesh. This is accomplished in a hydroseparator, a machine shown in the accompanying illustration. This devise is in construction the same as a "thickener"; it is, however, used for a different purpose. It consists essentially of a circular tank fed with a thin pulp at the center of the top and provided with an annular overflow launder inside the circumference at the top. At the bottom of a very slowly revolving shaft are four steel arms fitted with angle iron plow blades, set at such an angle that they sweep the sludge that forms from the settling of solid particles toward the center. The thickener was originally designed to dewater a pulp by producing a continuous and virtually clear overflow at the top, and at the bottom a thick sludge.

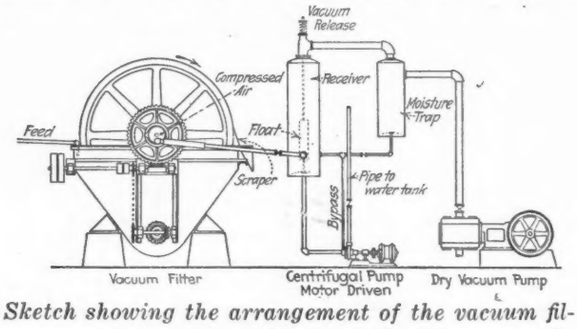
The adaptation as a hydroseparator was the consequence of the need for classifying a mixed pulp so as to produce a thin pulp from which all particles coarser than 300, 400, or even finer mesh had been eliminated. A 200-mesh product could be obtained efficiently from a bowl classifier (which I shall describe presently), but when it came to the very fine sizes, it was found that something else was necessary. The development of the hydroseparator was the consequence of this need. Instead of a clear overflow, the overflow of a hydroseparator is a thin pulp containing the finer particles that enter in the feed. By adjusting the height of the overflow launder in a tank of given diameter, for a standard rate and character of feed, an overflow with any desired maximum particle-size can be obtained.

The bowl classifier, which is also illustrated here, is a development of the plain rake classifier. The original machine consists essentially of a steel containing-tank, rectangular in shape and with a sloping bottom. A set of rakes, having a combined horizontal and vertical reciprocating motion, serve to drag the coarse or more quick-setting particles of a mixed ore pulp up the incline to a discharge launder, while the bulk of the water in

which remain suspended the finer particles runs over a wier-like partition at the lower end. With this has been incorporated the "bowl" seen in the illustration. In the bottom of this bowl is a mechanism simpler than, but designed to serve a similar purpose as, the rakes in the hydroseparator.

The feed is carried to the center of the classifier bowl, the fines overflowing with a large proportion of the water. The settled particles pass to the tank compartment through an opening in the center of the bowl bottom, where any really fine material is kept in suspension as a result of the movement of the reciprocating rakes. Enough water (known as backflow wash) is added to the tank compartment to cause a slight upward current to rise through the opening in the bowl, so that sufficiently fine material is returned to the bowl and overflows it. The gritty and heavier particles washed practically free of fines are discharged from the tank compartment by means of the reciprocating rakes.

The arms of the hydroseparators in this particular plant revolve at 0.5 r.p.m. The products are: (1) The overflow having a dilution of 24 parts of water to 1 part of solid; of the solid matter 94 per cent will pass a 300-mesh screen. (2) The underflow, which contains virtually all of the grit but which is not free from the finer material. To save this intermixed minus-300 chalk, the underflow is diluted to 7½ parts water to 1 part of solid and fed to the Dorr bowl classifier, the rakes of which



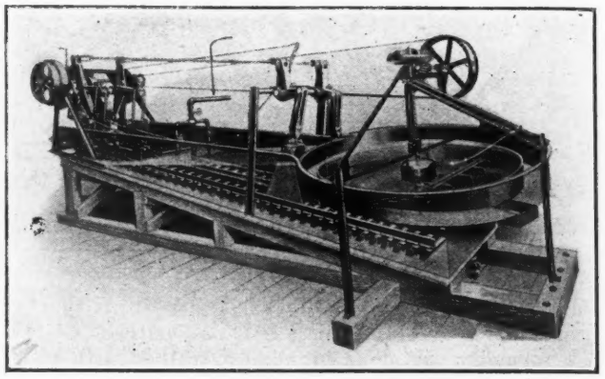
Sketch showing the arrangement of the vacuum filter and auxiliary equipment

operate at eight strokes per minute, while the bowl-arm revolves at 1.5 r.p.m. The overflow from the bowl returns to the hydroseparators with a consistency of 17 to 1, and the washed or deslimed grit, containing 40 to 45 per cent moisture and 3.2 per cent silica, is saved as a finished product, though a much less valuable one pound for pound than the finer minus-300 material. The following are typical analyses of the classifier products, showing the efficiency of the separation:

Mesh	Bowl Overflow, Per Cent	Rake Product, Per Cent	Mesh	Bowl Overflow, Per Cent	Rake Product, Per Cent
+10	.....	0.84	+200	0.62	17.20
+35	.....	1.30	+300	4.38	12.60
+65	.....	4.37	+325	8.08	4.88
+100	.....	13.20	—325	86.92	32.60
+150	Trace	13.10	.....	.....	.....

The bowl classifier and hydroseparator are in effect in closed circuit, in that the only product going to the dewatering equipment is the overflow from the latter. This is pumped to a distributing box, whence it gravitates to three single-tray thickeners, which are settling machines giving a continuous overflow of clear water and a continuous discharge of thickened chalk sludge. The overflow water is again used.

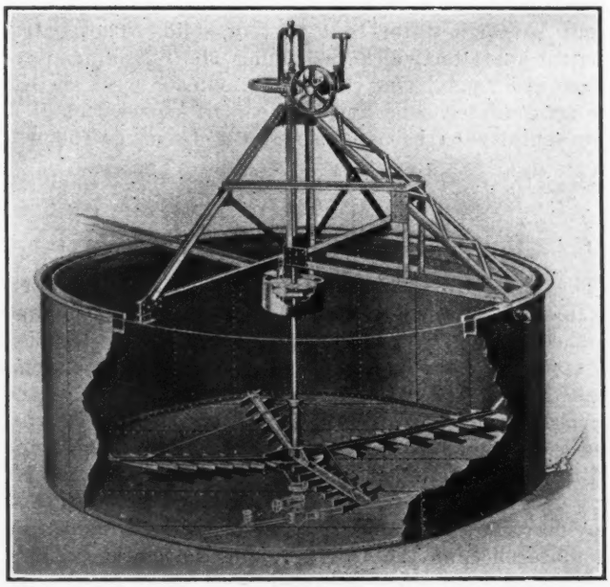
The sludge is pumped to two storage tanks which supply the feed to the revolving vacuum filter. The filter consists of a drum or cylinder, the lower portion of which is submerged in a tank (an integral part of the machine) containing the material to be filtered. The revolving shell consists of an inner air- and water-tight backing and an outer surface which forms the filter medium.



The bowl classifier. The side is removed to reveal the rakes

Arranged radially in the hollow interior of the drum is a system of pipes connecting each of the twenty-four compartments, into which the drum is divided, lengthwise, to an automatic valve that applies vacuum or compressed air to the compartments at the appropriate stage in the filter cycle. As a segment of the surface of the slowly revolving drum enters the pulp to be dewatered, the vacuum is automatically applied to the compartment corresponding to that segment. The water is sucked through the canvas and the whiting collects as a damp cake on the surface. The vacuum is maintained after the segment emerges from the pulp and further drying is effected. Just before the segment reaches the scraper in its downward journey to re-enter the pulp, the vacuum is cut off and compressed air is applied through the shell. This loosens the cake and assists the operation of discharging.

A dry vacuum system is used, 22 in. being maintained on both the cake-forming and drying parts of the filler. The cake as discharged contains 23½ per cent moisture. This is good, considering the character of the pulp—that is, the almost complete absence of any coarse particles

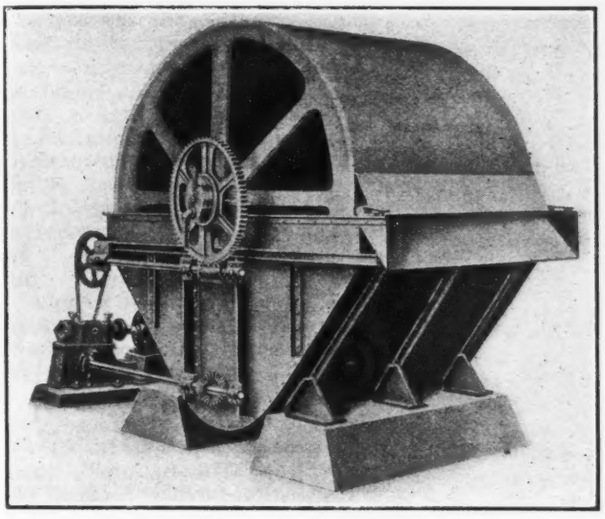


Hydroseparator for classifying 300-mesh material

to make the cake porous. A feature is a "beating" device consisting of a revolving shaft paralleling the main shaft of the filter drum at a point 18 in. above the highest point of the drum, to which strips of rawhide are attached in such manner that they beat and slightly jar the cake. To prevent cracking of the cake a canvas cloth is interposed to receive the direct blow of the rawhide strips. This is fastened to and hangs from a rod beneath the beater shaft in such a manner that the loose side drags along the cake. Since the installation of this device the cake has been dryer, and it has been easier to scrape from the drum. The cake averages ¼ in. in thickness.

Drying Problem Solved

Immediately adjacent to the filter is the rotary drier. L. R. Christie selected this particular type of machine

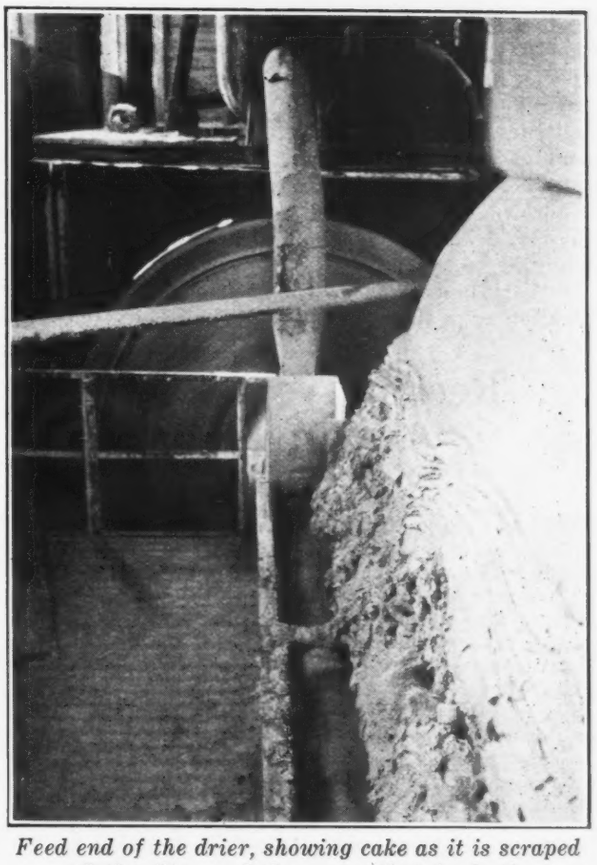


The vacuum filter. This machine drys the sludge of very fine material to 23½ per cent moisture

from those that his company manufactures after making a thorough study of the rather unusual conditions. Some of the features may be mentioned:

1. The product must not be discolored either by overheating or by contamination with foreign material. A temperature of more than 250 deg. F. at any time or the application of new heat after the moisture has been reduced to 1½ per cent causes the whiting to turn yellow. This is overcome by applying the heat at the feed end and by careful regulation of the temperature by using oil as fuel.

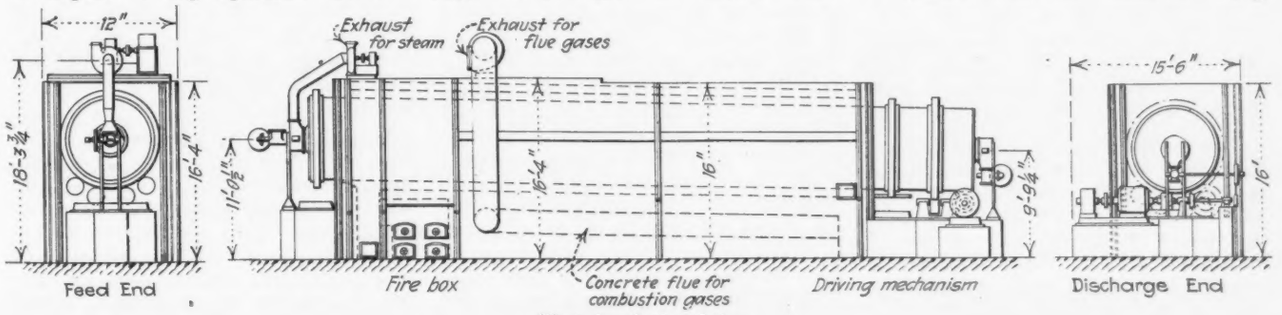
2. When fed to the drier the wet chalk has a consistency something like thin tooth-paste, and as it is introduced by means of a screw feeder it behaves like tooth-paste being squeezed out of a tube. If it were



Feed end of the drier, showing cake as it is scraped off the filter and the screw that feeds the wet material to the dryer

dried slowly at first it would form balls that would be very difficult to dry thoroughly. The firing at the feed end, whereby the freshly filtered product enters the hottest part of the drum, results in the generation of steam, which blows the lumps to pieces and permits thorough drying. It is essential that the moisture in the finished product does not exceed 0.7 per cent. The drier usually does better than this. The temperature of the discharged product ranges slightly above 100 deg. F.

3. The material is very fine and is of comparatively high value. Accordingly the dust loss must be kept at the minimum. To meet this requirement the feed and discharge openings are sealed and all joints are closed, so that practically no air passes through the drying compartment. The evaporated moisture is withdrawn at the feed end by means of a high-pressure exhauster which creates a slight vacuum. In this connection it may be remarked that very frequently, in the consideration of drying problems, it is assumed that sufficient air should come in contact with the material being



Sketch of the drier

dried to absorb the moisture. This is not true. On the other hand, every pound of air that passes out of the drier carries heat with it—heat that is lost and wasted. Under the same conditions of temperature, the less air the better, but then the moisture must be exhausted as steam or vapor.

In the Benjamin Moore plant no dust whatever is withdrawn from the drier and no dust collectors are required. The accompanying illustration shows the feed end.

In conclusion I want to emphasize one feature of the operation of a plant of this kind—namely, the desirability of continuous and regular running. Twenty-four-hour operation is vital if the most efficient results are to be had. The rate of feed of chalk and water should be approximately uniform, and adjustments, when properly made, should be maintained. Erratic results are certain during periods of starting and stopping. This is especially true of the operation of the hydroseparators and classifiers where the uniformity of the product depends upon definite conditions such as the rates of feed and the dilutions of the various pulps. It is better to run half the plant all the time than to run all of it half of the time.

Recent Technical Publications

Reviews, Abstracts, and References

Silica in Canada—The Canadian Department of Mines has recently made a study of the occurrence, exploitation, and uses of the various forms of silica produced and consumed in the dominion. A report, Bulletin No. 555, pp. 126, has been issued recently, this being Part 1 devoted to eastern Canada. Copies may be obtained on request to the Department at Ottawa. The bulletin first gives a general description of the various forms of occurrence of natural silica, such as quartz, chalcedony, opal, flint, quartzite, sandstone, sand, diatomaceous earth, and tripoli. Then comes a discussion of the structural and geological features of the various types of deposits in eastern Canada, in which commercial forms of silica occur; and a chapter on the occurrences of silica in eastern Canada follows. Thirty-five pages are devoted to laboratory tests. Two of the chapters will be as interesting to readers in the United States as to those in Canada, that devoted to the industrial uses of silica, and that to proving and operating silica deposits. Good topographic maps are appended, showing favorable areas for development, including the district around Montreal and the Ottawa area.

Chinese Metallurgy—"Some Chinese Metallurgical Appliances" are described by A. S. Wheler in a 23-page paper in the August *Bulletin* of the Institution of Mining and Metallurgy. (Separates obtainable for 1 shilling each from the offices of the Institution, Cleveland House, 225, City Road, London, E. C. 1.) The equipment described is mostly crude and home-made, but can be made to pay where labor is cheap and there is no competition from more efficient processes. The paper discusses the methods used for recovering gold, lead, zinc, tin, arsenic, mercury, and sulphur.

Malay States—The Annual Report for 1922 of the Federated Malay States may now be obtained from the Government Printing Office, Kuala Lumpur. It contains an excellent colored map of British Malaya.

Mineral Resources—The preliminary summary of "Mineral Resources in the United States in 1922," 124 pages, is now obtainable from the U. S. Geological Survey, Washington, D. C. It contains statistics of production of ores, metals, and non-metallic minerals for the last two or three years.

British Columbia—"British Columbia as a Mining Province" is the title of an 8-page article in the August *Mining Magazine* (price 1 shilling; Salisbury House, London Wall, London, E. C. 2), which describes briefly the diversified mining fields of the province and suggests central treatment plants as being the best means of handling the product of the numerous small properties.

Copper in New South Wales—Bulletin No. 3 of the Geological Survey of New South Wales, Sydney, 51 pages, is entitled "Copper." We note that "the (copper) industry has been handicapped in Australia owing to several causes, principal among which are the fixing of copper prices in England and the United States; the consequent heavy costs of transport thither from Australia; the distance of many copper deposits from railway communication, with consequent heavy costs of transport; and the relatively small tonnage and the low grade of the majority of the deposits." So far as the *fixing* of prices goes, the writer means that the principal market for copper is in England and the United States, and that, as Australia does not use much copper, it costs too much to get it to consumers in Europe and America. So the copper production of New South Wales has dwindled to about 500 tons per year, with the Cobar mining region dormant. The various occurrences of ore and the condition of the industry are discussed in this booklet.

Fuel in the Home—Technical Paper 315, 21 pages, obtainable on request from the U. S. Bureau of Mines, Washington, D. C., is entitled "Comparative Tests of Byproduct Coke and Other Fuels for House-Heating Boilers." With much of the old-fashioned fuel scarce and high priced, the house owner is urged to investigate the merits of coke, this being cleaner and more satisfactory than most of the lower grades of coal.

Leaching at Anaconda—*The Anode*, the monthly house organ of the Anaconda Copper Mining Co., Butte, Mont., has for some time been publishing very readable descriptions of the various technical operations of the company. In the August issue the 2,000-ton leaching plant at Anaconda is described. This plant handles tailing containing about 13 lb. of copper and ½ oz. silver per ton, and also oxidized ores. Leaching with salt has been discontinued since 1919. With salt, about 50 per cent of the silver was extracted, but with sulphuric acid only, not more than 5 per cent is extracted. About 75 per cent of the copper is extracted by either method. Precipitation is accomplished with scrap iron, using 1½ lb. of scrap iron per pound of copper produced. The cement copper averages 70 per cent.

Theory of Grinding—"A Contribution to the Kick vs. Rittinger Dispute" is given by H. E. T. Haultain in a 6-page paper prepared for the A.I.M.E. and obtainable from the secretary of that organization, 29 West 39th St., New York City. Professor Haultain finds that "in each set of experiments both the Rittinger and Kick figures are far from the actual results."

Platinum Fakes—"Platinum Assays and Platinum Promotions," a bulletin of 21 pages, has recently been issued by the U. S. Bureau of Mines, Washington, D. C., as *Reports of Investigations*, Serial No. 2,496, obtainable on request. All those who think that they have platinum deposits should provide themselves with a copy of this paper, which was discussed in an editorial in the *Journal-Press* in the Aug. 18 issue. In every case studied by the Bureau—and there were a lot of them—not more than a trace of platinum was found, and the names and addresses of assayers who found more than this are published. If platinum is present in commercial quantities it can be determined by standard methods of analysis; there are no secrets except on how to gull the public.

Determining Air Currents—U. S. Bureau of Mines *Reports of Investigations*, Serial No. 2,505, 2 pages, obtainable on request from the Bureau at Washington, D. C., describes a simple apparatus for generating streams of sulphur trioxide smoke, which is useful in studies of mine and tunnel ventilation.

SOCIETIES, ADDRESSES, AND REPORTS

Second Week of Canadian Convention of A.I.M.E. Closes with Reception and Technical Sessions

Inspection of Thetford Mines and Excursions to Historical Points of Interest in Quebec and Montreal Mark Termination of Memorable and Highly Interesting Meeting

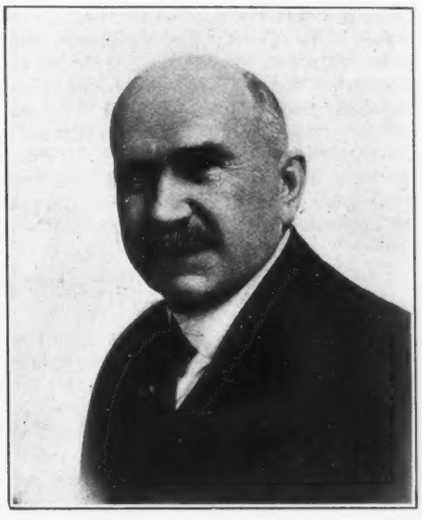
BY R. DAWSON HALL

SLIGHTLY diminished by those who had come solely for that part of the trip which lay in the Province of Ontario, the members of the American Institute of Mining and Metallurgical Engineers, in continuance of their summer jaunt, entrained in the afternoon of Sunday, Aug. 26, at Timmins, Ont., for Quebec. Chief among those who departed earlier in the afternoon by the Toronto train were the Hon. Charles McCrea, Minister of Mines of Ontario, and his staff, the members of the Institute showing their appreciation of his courtesies and company by hearty cheers. The province, through its Minister of Mines, certainly had showed the Institute every possible kindness and given it every conceivable assistance in comprehending the wealth and possibilities of Ontario's mines.

The journey through Porquis Junction and Cochrane to Quebec, which occupied over twenty-four hours, was notable in that it was made ahead of schedule, the party arriving in the "Gibraltar of America," Quebec, late in the afternoon of Monday, Aug. 27, and threading its way in automobiles past calèches and victorias, cannons and mortars, all fond survivals of an earlier time, up the steep and winding roadway to the modern but impressive Chateau Frontenac, where the party was to make a short stay. The Chateau, built on historic ground, occupying, as it does, the site of Chateau St. Louis, once the vice-regal residence of the Governors of Canada, is in itself one of the show places of a city that is little disposed to regard any new creation as worthy of note.

The Province of Quebec welcomed the visitors to its confines at an informal dinner that evening, the addresses of greeting being made by the Hon. Frank Carrel, Member of the Legislative Council, and Colonel A. A. Wood, the historian of Quebec.

Tuesday proved that the smiling fields around Quebec do not attain their intense verdure without rain. The automobiles conveying the visitors to points of interest in Quebec and its environs had barely started when the rain began to fall, and with trifling cessations continued to fall all day. In the morning a visit was made to the historic Citadel,



E. P. Mathewson, the genial president of the A.I.M.E.

the Battlefields Park, the Franciscan Monastery Church, Sillery, Quebec bridge, and the village of St. Foy. Quebec bridge has a span of 1,800 ft. and a total length of 3,239 ft., the total depth of its gigantic main posts being 320 ft. In the afternoon the party drove in the opposite direction down the St. Lawrence, visiting Beauport, Montmorency, L'Ange Gardien, Chateau Richer, and Ste. Anne de Beaupré, with its notable shrine and a cyclorama by the artist Paul Philippoteaux. On the return a visit was made to the Montmorency Falls.

ASBESTOS MINES PROVE INTERESTING

That same evening the train left for Thetford Mines. The principal visit of this trip was made to the plant of Keasbey & Mattison Co., known as the Bell Asbestos Mines. The asbestos is taken from a pit about 300 ft. deep. When the mine first was started the site of the pit was a hill 90 ft. high. A large fireplace in the office shows by a careful selection of the rocks out of which it is built the metamorphosis of peridotite into serpentine and finally into asbestos. At this mine the high-grade mineral is removed by pickers, who mingle with the miners when they are loading the excavated rock. The high-grade stock thus segregated is thrown into large boxes, which are removed by locomotive cranes. The run-of-pit is about 7 per cent asbestos, but only about 1½ per cent of the whole output is high grade. The values in the pit are neither rising nor declining with depth. The miners receive 17½c. per ton for mining and loading the crude rock, the average wage being about $4.50 per day, which shows that each man produces a fair tonnage. Twenty tons per day is considered a minimum output per man. The pit is approached either by stairways on the edge of the pit or through a haulage tunnel excavated in solid rock which has a slope of 10 per cent. Though a wide double-track roadway it holds its shape without timbering except at the portals.

The high-grade rock is crushed by boys with hand hammers. They remove the asbestos fiber and send the waste to the mill, where by crushing, screening and suction in stages all the fine asbestos is removed. In a test room the fiber is screened by a perfectly regulated method and for a certain definite time, and the percentage of each size of fiber is thus determined. Of course, fibers are held on a screen with difficulty, even a 6-in. fiber going readily through a small hole if rightly presented, but by standard screening for a given time an excellent analysis can be made of the length of the fiber.

Some of the visitors went to the Consolidated Asbestos, Ltd., where samples of asbestos were presented to everyone in the party. This company has a mine as well as a pit. Several of the party descended the mine. In the pit a steam shovel loads the rock. The mine-run is picked at the mill, which is a favorable method of handling it, for both high-grade and low-grade asbestos must be subjected to treatment, and the mill is therefore a suitable place at which to perform it.

Under the leadership of J. A. Dresser, several of the geologists motored to Black Lake, and in the woods inspected an exposure of peridotite which exhibited clearly how the peridotite had changed to serpentine in the plane of alteration and how again part of this serpentine equidistant from its surfaces

J. V. N. Dorr was among the New York members of the A.I.M.E. who made the trip

had changed to asbestos. Returning to the plant of the Asbestos Corporation of Canada, recently crippled by a serious conflagration, the strip pit was visited. Here the hill had been 100 ft. high, but now a chasm 350 ft. deep replaces what was formerly an eminence. The material from the pit is hoisted by cableways supported by towers on either side of the excavation. These towers run on wide-gage tracks, and the 70-ton dead-men by which the loads are balanced are mounted on wheels so that they can be made each to follow its tower in its travels along the track.

Kick vs. Rittinger Dispute Gets an Airing

The train left Thetford Mines soon after noon, and arrived at Montreal that evening, the members being quartered at the Mount Royal Hotel. On the day following four sessions were held, one for mining and milling men, one for geologists, and two for iron and steel men. The mining and milling session was presided over by John A. Dresser, president of the Canadian Institute of Mining and Metallurgy. The first paper, entitled "Contribution to Kick vs. Rittinger Dispute," by H. E. T. Haultain, was discussed by Professor Bell, of McGill University. The latter quoted with approval Professor Gates as saying that the only way to find out what happened in a ball mill was to take it to a laboratory and ascertain the action by careful investigation. No fine-spun theories would serve instead. This is what Mr. Haultain has done. In a mill crushing 100-mesh ore, he finds that Rittinger's power figures are nearly 1.5 times too large, but in the same case Kick's results are one-seventh what they should be. It is clear, said Professor Bell, that Kick's figures for fine material are no less than absurd. He was afraid that Haultain had been too kindly to Kick and he remarked that the experts who favor Kick are disposed to experiment on anything but rock.

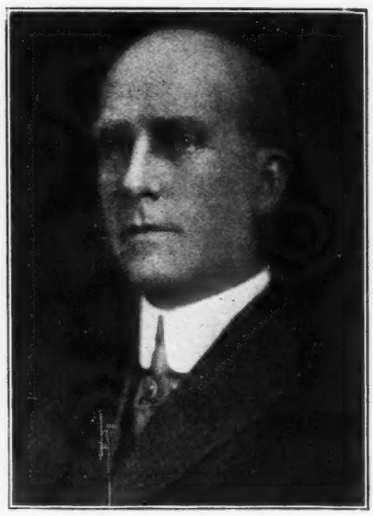
Mr. Haultain thereupon for himself and F. C. Dyer exhibited several intensely interesting "New Slow Motion Pictures of Ball Paths in Tube Mills and of Rock Crushing in Rolls." E. P. Matthewson read a letter from Prof. E. W. Davis, of the Bureau of Mines Experiment Station at Minneapolis, Minn. Professor Davis had made a careful investigation of Mr. Haultain's motion pictures and concludes that they corroborate his careful analysis of what takes place in grinding by ball mills. Till he gives his views it would be premature to deny his contention. It is clear that the balls do not fall to the bottom of the mill, but drop down on to a bed of balls and roll back to form a toe at the foot of the fall. The small balls take to the periphery, and with increased speed the quartz takes the same course. It was noted that the disks used in place of balls revolved as they rose, their relative motion evidently causing much attrition. It was obvious, also, that the water in the wet mill greatly reduced the impact of the balls.

Classifying Action of Balls Not Demonstrated

The views shown were all as of a cross section of a mill. Nothing could be expected therefore to be shown of the classifying action of the balls in the direction of the axis of the mill—a feature that is regarded as of great importance by the manufacturers of the Hardinge equipment. The views were taken through glass, the tube mill being revolved as nearly as possible at the speed regarded as most favorable for crushing. This was photographed at the rate of 120 to 125 impressions per second and run off at the rate of 15 to 16 impressions per second, so as to make it easy to see just what happened, which it would have been impossible to note if the reel were run at the higher speed.

The motion pictures of crushing showed that the action of some rocks was almost explosive under pressure. A glass ball dropped between the rolls revolved under friction, first in one direction, then in another. The fractures in the rock joined the points of pressure on the opposing rolls. The Institute expressed itself as much interested in the films and as being of the opinion that the investigations should be carried further, if possible. S. J. Cook, chief of the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, presented the newly issued "Preliminary Report of the Mineral Production of Canada, During the Six Months Ending June 30, 1923," saying that it showed an increase of 44 per cent in the value of the minerals, metallic and nonmetallic, in the first half of 1923 over the value of the same minerals in the first half of 1922.

R. C. Canby read the paper by Arthur



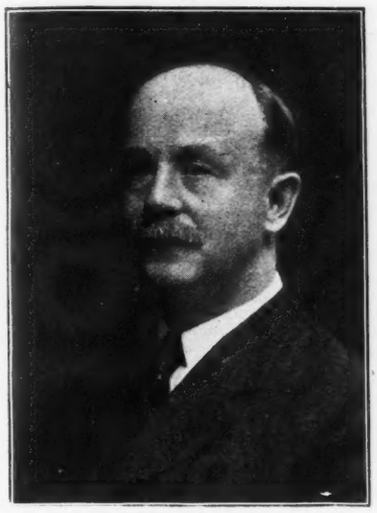
Dr. Richard B. Moore, who has been in charge of the Government's helium program, accompanied the party

Crowfort on a "Proposed Plan for Crushing, Grinding and Concentrating Low-Grade Sulphide Copper Ore." He said that Dr. Ricketts had remarked some years ago that flotation eventually would be performed in a launder with air passing through a porous bottom. Mr. Canby laid stress on the importance of the bubble column and said that the pulp could be quite shallow, but that the need for an adequate bubble column was the foremost necessity.

In the absence of the authors and in view of the shortness of time available, the three papers "Mining Methods at Bawdwin Mine, Burma," by A. B. Calhoun; "Emergency Power for Mines," by Graham Bright; and "Loading Ore Underground with Scrapers at the Utah-Apex Mine," by S. P. Holt, were not presented.

At the Geology Session in the afternoon Frank L. Hess, of the U. S. Geological Survey, presided. Dr. Richard B. Moore discussed his paper on "Helium, a National Asset." Charles P. Berkey briefly described a paper presented by himself and J. H. Sinclair entitled "Cherts and Igneous Rocks of the Santa Elena Oil Field, Ecuador." Sherwin F. Kelley spoke generally on the "Practical Results Obtained by the Schlumberger Method of Electrical Prospecting" in his presentation of a formal paper on that subject. G. W. Bain not being present, his article on "Magnesite Deposits of Greenville, Quebec," was used by title. Mr. Stines, in the absence of C. Erbwuensch, briefly described "Secondary Enrichment at the Eagle Mine, Bonanza, Colo.," and Louis D. Huntoon let loose all the pent-up geologic energy of several disputants by his interesting references to the meat of his paper on the "Porcupine Ore Deposits."

In the absence of J. W. Reynders, William Kelly acted as chairman at the meeting of the Iron and Steel Session. In the morning Ancel St. John pre-



C. V. Corless, of the Mond Nickel Co., was prominent among the Canadian members

sented not only his own article on the "X-Ray Examination of Irregular Metal Objects" but also the paper prepared by H. H. Lester on an "X-Ray Examination of Steel Casting." C. Baldwin Sawyer's paper on "Nitrogen in Steel" then followed. In the afternoon four papers formed a basis for discussion, a fifth being used by title.

The evening brought the only really full-dress event in the trip—namely, the presentation of the members to the Hon. Charles Stewart, Dominion Minister of Mines, and the Hon. Charles McCrea, Minister of Mines of Ontario, the latter returning to the party at Montreal to wish it godspeed. At the banquet which followed, the speakers were the statesmen mentioned, T. C. Denis, superintendent of mines, Province of Quebec, Bureau of Mines, and John A. Dresser, with E. P. Matthewson as toastmaster.

Sightseeing Ends Tour

The next and last day was given to sightseeing. In the morning those who took the shorter trips went to Nôtre Dame, viewed the city from one of its skyscrapers—only 125 ft. high, as building regulations prohibit any greater height—studied the antiquities at the storied Chateau de Ramezay, attended an exposition of furs, or the Eglise de Notre Dame de Bon Secours, saw McGill University from a distance, examined the Art Gallery, visited Westmount, Montreal West, and the Lachine lock and rapids. Late in the afternoon they took the steamboat "Empress" at Lachine wharf, navigated the treacherous rapids with four men at the wheel, and returned on the boat to Montreal.

Others took the train upstream to Cornwall, Ont., and the boat from that point down the river through Lake Francis, Coteau Rapids, Cedar Rapids, Split Rock Rapids, Cascade Rapids, and Lachine Rapids. This ended the trip.

To the golf experts who went along there were neither mines nor rapids but only putting greens and hazards.

Proper Use and Care of Drills Necessary to Avoid Waste

J. H. Jowett, in Interview, Points Out How Great Saving May Be Effected by Watching the Scrap Pile—Cites Report of Federated Engineering Societies Committee

INTERESTING FACTS as to economies that may be derived from the proper upkeep of drilling equipment were recently given one of the editors of the *Journal-Press* in the course of an interview with J. H. Jowett, vice-president and general manager of the Ingersoll-Rand Co. Mr. Jowett and some of his associates recently made an extended trip through several of the western states to study the existing mining situation at first hand. The importance of service following a sale was emphasized by Mr. Jowett, who also pointed out what a great saving could be effected by the proper use and care of equipment and supplies. He referred to the report of the Committee on Elimination of Waste in Industry, appointed by the Federated American Engineering Societies, which demonstrated the waste prevalent in five of the major departments of industry, including the metal and building trades. The report asserted that huge sums were wasted yearly which could, for the most part, be saved through greater care and proper methods. In the specific matter of proper use and care of drilling equipment, Mr. Jowett showed how present wastage could be converted into an important saving, particularly by taking advantage of the drill manufacturer's service. Said Mr. Jowett:

"Rugged as the up-to-date pneumatic drill is, and capable as it is of driving a steel through any sort of rock, nevertheless it is a piece of machinery that calls for a good deal of understanding care. Not only that, but if a proper measure of care and attention is not given it, the drill will require more than the normal amount of repairs. The pneumatic drill is a striking example of the adage, 'A stitch in time saves nine.' Further, its career in a mine emphasizes the well-known but neglected fact that it costs money to move anything any distance, no matter how short. And this brings us to that outstanding problem, proper service.

"In certain of the more progressive mines, it is the custom to carry the drills back from the heading to some convenient point underground at the end of every shift so that the tools can be examined and overhauled on the spot. In this way minor shortcomings can be detected and corrected promptly and the drills quickly made ready again for use. The expense involved is trifling compared with that entailed when drills are taken all the way to the surface and there turned over to the repair shop. In other words, frequent inspection underground offsets a rather common tendency on the part of the drill runner to carry on with a defective or limping tool until the machine is put out of commission because of a really serious breakdown.

"Of course, it is not possible to give drills 'the once over' at the end of every shift unless men trained for that work are at hand, This schooling is part of the duty of the manufacturer's service men kept continually in the field. The ultimate value of this service can hardly be estimated; and operating officials familiar with it prize it highly, inasmuch as they are better able to appraise the resultant benefits. Naturally, the service man knows the pneumatic drill thoroughly and is fully alive to just what it can do and what should be expected of it under any condition in practice.

"A good many mine operators have yet to learn that a great deal of money can be saved by keeping a sharp eye on the scrap pile. All too often a perfectly sound drill part is discarded when a reasonable amount of familiarity with the tool and intelligent scrutiny would have revealed the part that was causing the trouble and which should have been scrapped instead. Mark you, those drills are manufactured by repetitive processes which make the component parts interchangeable; therefore no part of those tools should be thrown aside until it is known to be worn out. More than once, service men have cooperated with the repair-shop boss in a friendly wager that a saving of 20 per cent was possible in tool upkeep. They have invariably made good; and this has been accomplished largely through watching closely what went on the scrap heap. Nothing that could be utilized was cast aside.

"And this brings us to another phase of service—that of seeing to it that the customer obtains replacements with dispatch and whenever they are needed. A very common practice with many big mining operators and engineering contractors is to carry in their own storerooms large quantities of reserve equipment. Apart from the overhead, which must be paid for sooner or later, insurance, and the cost of maintaining storage facilities, this procedure has often found the owners overstocked with certain tools and parts."

Mr. Jowett pointed out how much better it was if this storage was done by the manufacturer, provided he had intimate knowledge of the customer's needs, continuing:

"Just what this system of storage means was brought out forcefully on one occasion when a much-used tunnel was suddenly blocked by fire. The situation was a serious one, and it was imperative that means be devised to open a way for traffic lest inconvenience and losses be suffered by merchants and a heavy drop in revenue result. The management called on the manufacturer and inside of two hours there were dispatched to the seat of trouble four portable air compressors, two pneumatic drill-steel sharpeners, numerous drills, sets of drill steels, and other necessary paraphernalia. The next morning, the men sent with that outfit were at work, and inside of eight days they had drilled and blasted a way around a hillside and had opened a route which side-stepped the obstruction."

MEN YOU SHOULD KNOW ABOUT

H. W. Turner is examining mines in San Luis, Potosi, Mexico.

A. J. Bone has returned to New York after a four months' absence in British Guiana.

George A. Packard, mining engineer, of Boston, Mass., was recently in San Francisco, Calif.

Nelson Dickerman has returned from British Guiana and is at the Hotel Lorraine, New York City.

F. Montijo, of the Moctezuma Copper Co., Nacozari, was recently in San Francisco on a vacation.

C. E. Mellen, field engineer for the Granby company, has spent several weeks in the Portland Canal district.

H. Stewart Martin, late consulting engineer for the Rand Mines group, sailed from South Africa to England on July 28.

J. Leonard Replogle has resigned as president and chairman of the executive committee of the Vanadium Corporation of America.

Earl R. Pilgrim, professor of mining and metallurgy at the Alaska College, is visiting mining properties in the Kantishna district.

G. B. D. Turner, consulting engineer for the Indian Mines Corporation, has left Stewart for Toronto, after spending two weeks at the mines.

C. W. Gudgeon, general manager of the Mount Bischoff Tin Mining Co., Tasmania, has resigned to take up commercial pursuits in Melbourne.

John L. Bray has resigned his position as metallurgist with the U. S. Tariff Commission to accept a professorship in metallurgy at Purdue University.

G. St. J. Perrott and S. P. Kinney, of the U. S. Bureau of Mines, in the past year have conducted an intensive study of the combustibility of coke in blast furnaces.

John D. Ryan, chairman of the board of directors; **C. F. Kelley,** president; and **J. R. Hobbens,** vice-president, of the Anaconda Copper Mining Co., are in Butte, Mont.

F. E. Scobey, Director of the Mint for slightly more than a year, has notified President Coolidge that he desires to resign that office, and will leave sometime in October.

Malcolm McLaren, of London, recently spent two weeks in the Portland Canal district, and visited all the important mines. He left Stewart for London on Aug. 13.

Ernest N. Patty, professor of geology and mineralogy at the Alaska College, has returned to Fairbanks after spending two weeks on field work in the Livengood area of the Tolovana.

V. L. Hardley-Wilmot, of the Mines Branch, Canadian Department of Mines, is conducting an examination into the deposits of natural abrasive materials in Canada and the processes employed for preparing them for market.

Reginald E. Hore, formerly of the faculty of Houghton College, is secretary of the Iron Ore Committee of Ontario, the report of which is now in the hands of the provincial government.

Reginald E. Hore

Cyril W. Knight, associate geologist of the Ontario Department of Mines, left the government service on Sept. 1 to take a position with the Nipissing Mining Co.

Cyril W. Knight

Dr. T. T. Read, formerly Chief of the Division of Information Service in the Washington Office of the U. S. Bureau of Mines, has been transferred to Duluth, Minn., and made superintendent of the North Central Experiment Station.

Albert B. Bartlett, State Geologist of Wyoming, is directing the preparation of a bulletin covering the oil and gas developments in the Big Horn Basin, of that state, an area about 100 miles square and containing eight structures, some of which have proved productive.

E. F. Ellsworth, of the Canadian Geological Survey, is investigating the radioactive minerals of Ontario and Quebec, and will also examine occurrences of the minerals of rare elements, including cerium, beryllium and zirconium, for which there is a growing demand.

Dr. T. W. Vaughan, of the U. S. Geological Survey; **Dr. R. W. Brock,** of the University of British Columbia; **Colonel A. A. Brooks,** of the U. S. Geological Survey, and **N. M. Fenneman,** of the University of Cincinnati, attended the Pan-Pacific Congress in Sydney and Melbourne, Australia, last month.

Charles F. Jackson will sail from New York on Sept. 22 for the Island of Cyprus, where he has accepted a position with the Cyprus mines corporation. Mr. Jackson has been engaged in consulting work with Crowell & Murray, of Cleveland, and has also been active in connection with the work of the Mining Methods Committee of the A.I.M.E.

Freeman Ward, State Geologist of South Dakota, has four parties in the field this season. The first, under **W. H. Over,** is studying natural history and archaeology in the eastern part of the state; the second, under **E. P. Rothrock,** geologist, is conducting research on road and structural materials; the third, directed by **E. L. Troxell,** is studying fossils and stratigraphy, and the fourth, under **G. F. Moulton,** geologist, is conducting an investigation of possible oil structures.

OBITUARY

John T. Overbury, one of southern Nevada's prominent mining men and interested in properties at Rhyolite during the early days, and **Henry Weber,** a pioneer of Goldfield, were killed when an automobile in which they were returning from Death Valley to Tonopah overturned near Divide.

Daniel Best, inventor and manufacturer, and an early pioneer of the West, died recently in San Leandro at the age of eighty-five. He founded the Best Manufacturing Co., of San Leandro, Calif., and the Best Tractor Co., both of which companies are now known as the C. L. Best Tractor Co. C. L. Best is the son of Daniel Best. Daniel Best early showed marked mechanical ingenuity and found many opportunities in the lumber and mining industries for his abilities. His traction engine, which was invented in 1887, became widely popular. Daniel Best was one of the great men of the West, virile and successful.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

COMMENT in London papers indicates that English financial houses resent the proposal to form an association in America for the marketing of silver. Interests are in conflict.

The new 2,500-ton concentrator of the Consolidated Mining & Smelting Co. at Kimberley, B. C., was started on Aug. 22.

A team from Benton, Ill., takes first honors in the mine rescue contests at Salt Lake City.

Leadville operators see the coming of a new era in the development of processes for successfully concentrating low-grade ores from the district.

Mother Lode gold mines in California are working at near capacity.

A group of London interests has abandoned options on several British Columbian mine options. Prices asked are too high, it is said.

Rich new oreshoots are reported in the Iron Blossom mine, at Eureka, Utah.

Californian quicksilver mine, New Almaden, celebrates its one-hundredth anniversary.

Colorado mine operators advocate formation of an American silver export association as they leave for the Reno conference.

The Federal M. & S. Co. is developing a number of bonded properties in the Northwest.

Dome Mines is arranging to sell 23,333 of treasury stock.

Federal A. S. & R. Subsidiary Works Four Northwest Properties

Has Old Minnie Moore Mine in Idaho and Prospects in British Columbia —Development Active

The large companies in the mining business in the Northwest are bending every effort to bring in new producers. The Federal Mining & Smelting Co. is now unwatering the extensive underground workings of the Minnie Moore mine, near Hailey, Idaho. It has for years been declared by those familiar with the property that a large tonnage of lead ore remained in the stopes of the mine at the time it was shut down about twenty-five years ago. The undertaking of unwatering and exploration involves the expenditure of large sum of money.

Among other exploration ventures of the Federal company are three properties in British Columbia on which exploration and development is being carried on under the direction of the Federal organization. One is a group on Hudson Bay Mountain, 12 miles from the railroad, the ore consisting of highly argentiferous galena, reported as averaging in carload shipments $100 per ton. Another property is the Fairview mine, in the southern part of the province, on which a 20-ft. quartz vein is being developed and upon which the erection of a concentrator is being considered. The Dome Mountain mine, 20 miles from Telkwa, is being actively developed by the Federal company with encouraging results.

Modern Sampson Invests in Nevada Mining Prospects

Aloys P. Swaboda, the "strong man," whose advertisements of physical culture training have made him famous, has just concluded negotiations whereby he will take a $120,000 interest in Nevada mining properties, according to Leo A. McNamee, of Las Vegas. One of the properties is situated near the Lander-Nye county line and the other is at Goodsprings.

Dome Treasury Stock Will Be Sold for $850,000

Alternative to Obtaining American Interests—Will Be Appropriated for Exploration

It is reported that the Dome Mines Co. of Porcupine, Ont., is arranging to sell the remainder of its treasury stock to the London firm of Heirch, Stokes & Wilson; the price is reported to be slightly in excess of current market quotations. The stock remaining in the treasury amounts to 23,333 shares, and this would bring about $850,000.

Negotiations are understood to have been under way for some time to take over some large American holdings, but this was found to be impossible, so it was decided to sell the treasury stock. It is believed that the money will be placed in a special fund to be used entirely for the acquisition of new properties and exploration work in connection with them. The Dome mill is treating approximately 1,250 tons a day, and gross revenue is over $400,000 a month.

Colorado Silver Producers Favor Formation of American Export Organization

Want Hearing at Denver—Disclaim Desire to "Fix" Prices—Restrain Manipulation

Colorado silver producers selected as their representatives at the Reno conference, called by the Senate Gold and Silver Commission, Bulkeley Wells; John Cortellino, mine operator at Leadville; Fred Carroll, general manager Atlas Mining & Milling Co., Ouray; R. M. Henderson, general manager Wellington Mines Co., Breckenridge; and Charles E. Anderson, general manager Smuggler Leasing Co., Aspen.

The Colorado delegation is disposed to favor the proposed export association, or some sort of an agency for marketing purposes, controlled by the producers. It is not thought that this agency should or could arbitrarily fix a price for the white metal, but, in accordance with economic conditions through co-operative effort, would be able to facilitate the marketing, prepare for seasonal demands, in a measure stabilize the price, and restrain unfair manipulation of the market for the metal.

Efforts will be made by the Colorado delegation to have one of the hearings held at Denver, as proposed by the commission, whereby accurate and definite information will be developed through personal contact with prospectors and miners. At these hearings to be held at various points in western mining states, miners and prospectors are to be asked to give their views.

British Will Fight Silver Export Association

"You Sell, We Buy—Why Should We Co-operate to Raise Prices," Say London Bankers—Admit Output Can Be Controlled

AMERICA'S proposal to organize a silver export association is not popular in London, according to a cabled dispatch to the *Wall Street Journal*. The article continues to say that not only will the British refuse to co-operate, but they are confident that they can defend themselves if it is organized. "Not content with cornering the world's gold supply, with seeking to own the second largest merchant marine and with enjoying the position of the biggest creditor nation on the earth, the United States would now seem to have an eye on Britain's silver market," is the comment of a London newspaper, which shows how the export association is regarded in London.

A leading silver trader is even more outspoken. "America is the seller and England the buyer of silver. Naturally Americans want to sell for as much as they can get and naturally we want to buy as cheaply as possible. It would be absurd to expect the seller and the buyer to co-operate to raise prices." On the prospect of the British having a government representative along with Americans in the association he declares, "you might as well expect our government to join an association devised to raise the price of wheat or cotton."

The British admit that Americans can succeed in controlling output and agree that an association is launchable commanding 70 per cent of output, which figure will rise in a few years to 80 per cent. However, taking a long look at the future, they are bearish. They believe the motive for the proposed association is to be found in the poor outlook for silver. Currency demands have declined. England is still using silver coins, but employs 50 per cent alloy. France, Germany, Russia, and Italy are certain to use either paper or base metal currency. American government purchases have ceased. India and China cannot be expected to expand silver currency to balance such losses.

It is pointed out here that control of silver prices is not a simple achievement. The supply of silver already marketed, but ready to flow back into trade, is large. Prices have only to rise a small margin to lure private owners to part with silver possessions. The London silver market on which American are supposed to be focusing envious eyes is, in personnel, a somewhat seclusive affair. The bulk of the orders are handled by four bullion houses, Samuel Montagu & Co., Sharps & Wilkins, Mocatta & Goldsmid, and Pixley & Abell. Representatives of these houses are proverbially believed to foregather daily and on the basis of orders and supply to fix the daily price of silver.

Three eastern banks, Hongkong & Shanghai, Yokoma Specie and Chartered Bank of India, are especially interested in the American proposition, because they finance eastern exchanges. They will be found mobilized against any American attack.

An impressive indication of the dimension of the British silver trade is found in the fact that exports to India in July were 7,953,314 oz., making seven months' total 44,162,573 oz., against 26,385,273 for the same months of 1922.

Prospecting Active in Kantishna District of Alaska

New Find Near Peter's Glacier—Guggenheims Busy—J. W. Quigley Takes Trip

By Our Special Correspondent.

Twenty prospectors, working over the Kantishna district and adjacent areas along the northern flank of the Alaskan Range, have reported several new finds that they feel will prove to be of unusual importance. An extensive area of mineralization has been discovered in the vicinity of Peter's Glacier, which is near the northern flank of Mount McKinley proper. The best of this ground has been located by Jiles, Shannon, and Carlson. These orebodies show mineralization in copper, lead, silver, and zinc and are reported to be extensive though irregular. They represent replacement of limestone adjacent to intrusions of granite. It appears that much of this country has never been gone over by prospectors, for the locators report that in some instances they were able to see the mineralized areas an hour or more before they were actually reached.

Knudson and Jiles report some promising discoveries near the headwaters of the East Fork of the Kuskokwim River. This is also an area adjacent to the Kantishna district, but is difficult of access.

The Guggenheim interests have a prospecting crew of eight men at work exploring some of the more promising showings on Copper Mountain of the Kantishna. Supplies for this work were taken in over the snow from the railroad last winter.

J. W. Quigley, who was one of the first prospectors in the district and who holds much ground of promise, left recently, in company with Mrs. Quigley, for an extensive visit to the States. This is their first trip out in more than twenty years, for Mr. Quigley came North in 1891, crossed Chilkoot Pass, and drifted down the Yukon years before the Klondike was struck and when the Forty-mile was the only placer attraction. Mrs. Quigley is hardly less a pioneer, for she came North during the time of the Dawson stampede in '98.

Forelight Mining Co. Resumes Manganese Production in Montana

OWNERS of the Forelight Mining Co., operating at Philipsburg, Mont., have just made a contract to deliver a large tonnage of high-grade manganese. The mine and mill will be started immediately and will employ about twenty men.

Illinois Team Takes Highest Honors in First Aid

Tourney Held in Utah—500 Contestants and Officials Attend Meet

National championships in first aid and mine rescue work were determined at Salt Lake City, Utah, on Aug. 30, when seventy-five teams representing coal and metal mines competed in the annual meet conducted under the auspices of the U. S. Bureau of Mines. Five hundred visitors attended the meet.

The team of the United Mine Workers of America from the Benton district, Illinois, took highest honors by winning the combination first aid and mine rescue competition. Winning of first place also brought this team possession of the silver cup donated by the National Safety Council. Second place in the combined competition was won by the team from the Independent Coal & Coke Co. of Kenilworth, Utah, and third place by the team from the Pacific Coal & Coke Co. of Black Diamond, Wash.

The Congressional bronze medallion, awarded by Act of Congress to the team winning highest first aid honors, was captured by the team from the Anaconda Copper Mining Co., Great Falls, Mont. Possession of several silver cups until next year's competition went with the winning of the first aid competition. Second place went to the team from the Clinchfield Coal Corporation, Wilder, Va., and third place to the team from the Danta, Va., mine of the Clinchfield Coal Corporation. Winners of the first three places in first aid were separated from each other by less than half of one point.

The mine rescue team from the Benton district took first place in the mine rescue competition, winning the Congressional bronze medallion and possession of several cups until next year, when they will again be placed in competition. Second place was won by the team from the Independent Coal & Coke Co., Kenilworth, Utah, and third place by the Mexican team representing the Real del Monte of Pachuca, Mexico.

The Joseph A. Holmes Challenge Trophy, awarded to the organization whose first aid team and separate mine rescue team has the highest average rating in both contests, was won by the Union Pacific Coal Co. teams from the Cumberland and Hanna mines, Wyoming.

London Group Abandons Denny Options, Salmon River

Fancy Prices Asked Assigned as Cause —$850,000 High for Even a Good Prospect

H. S. Denny, representing a group of London interests, has relinquished all the options that he held on properties in the Salmon River district, in British Columbia, and the engineers in charge of operations have returned to England. Mr. Denny spent about a month in the district, and when he left Stewart, on July 21, he was unstinted in his praise for the district, but would vouchsafe no information as to his intentions with regard to the properties that he had under option. The inference is, therefore, that his objections were to the terms of the options, rather than to the properties. Nor is this altogether surprising, as, it is understood, the price placed on the Daly-Alaska was $850,000 and that on the Big Missouri $750,000. Neither of these properties can be said to have been developed beyond the prospect stage, and, even though time were allowed to explore the property, an engineer does not want to develop a property for the privilege of paying a high price for it.

Leadville Operators Profess to See a New Era

Milling Is To Be the Salvation of the District—Must Concentrate Low-grade Ore—Two Mills Now in Operation

CONCENTRATION of millions of tons of low-grade ore left after the mining of 20,000,000 tons of shipping ore is the hope of the future of Leadville, Colo. Gustavus Sessinghaus and W. P. Cary have set themselves to the problem of devising means for concentrating this ore, of which there are two general classes. Sessinghaus has taken the siliceous sulphides and Cary the complex zinc-lead-iron sulphides.

The raw siliceous sulphide ores contain such an excess of silica as to make the smelter charges prohibitive. Sessinghaus plans to reduce this excess silica and make a shipping product. This he has done by experimental work with full-sized equipment in the Leadville District custom mill. The distinguishing feature of the process is that flotation is not now being used. The flow sheet shows standard practice of water concentration by jaw crushers, rolls, and tables, but with variations and adjustments, conceived by Sessinghaus and adapted to this particular ore —that is, iron pyrite carrying gold. The present mill, of 125 tons, daily capacity, is regarded as only a pilot plant to be increased in capacity as the process becomes perfected. Sessinghaus estimates that 1,000,000 tons of ore—in mines and on dumps—of this character, now valueless, can be treated at a profit.

Cary first made an exhaustive study of the district to satisfy himself that there was such a supply of ore as to justify the time and expense of extensive research and experimentation. The Norton mill was used as a basis of commercial work, but was entirely changed in equipment. Crushing is done with jaw crushers and a conical ball mill. The distinguishing feature of Cary's process is selective flotation of zinc in the presence of iron and lead, which is the direct reverse of ordinary practice. After being crushed in the ball mill, the ore goes directly to the flotation units. In the first section chemicals and oils are added. The product is zinc with a small amount of lead and iron. This goes to Wilfley slimers, where the lead and iron are taken out. In the second section of the flotation department other chemicals and oils are added and the coarse minerals floated off. This product contains coarse zinc, which goes to a Wilfley sand table, where the zinc product is cut out of the iron and lead.

The present mill has a daily capacity of 100 tons, but is being enlarged. Cary estimates that within eighteen months about 1,000 tons of this complex ore will be treated in mills to be erected in the district.

W. J. Loring Bonds Guadaloupe Mine, South of Parral

Property Is Well Equipped and Has a Good Production Record—Idle Since 1912

The Guadaloupe mine, 100 miles south of Parral, in the Inde mining district, Mexico, has been acquired under bond by W. J. Loring, of San Francisco. The first payment upon the property has been made. The Guadaloupe has produced $1,500,000 from 125,000 tons of ore. It was in full operation and making excellent returns in 1912 when the political turmoil of the period caused the property to be shut down until the coming of more tranquil times should make a resumption of operations practicable.

The property is fully equipped. A 100-ton mill and cyanide plant of steel construction is available. The steam-power plant is five miles distant and is of 150 hp. The plant is in excellent condition. The ore deposit is at the contact of limestone and porphyry, the ore occurring on the contact and also in the limestone. The blocked-out reserves are reasonably large.

Loring plans to organize a company to operate the property. According to Loring conditions in Mexico are now favorable, as recognition by the United States has added reason for expecting stability in the government and protection for industry.

News from Washington

By PAUL WOOTON
Special Correspondent

Colorado River Power Project Will Be Considered Sept. 24

Hearing on Girand Permit Ordered—States Invited by Commission to Send Representatives

A hearing which may be expected to bring out fully the conflicting views regarding power and irrigation rights along the Colorado River and which probably will have an important bearing on the pending compact among the states interested will be held Sept. 24 before the Federal Power Commission in Washington.

J. B. Girand, who holds a preliminary permit for development of a hydroelectric project on Diamond Creek, Arizona, recently wrote to the commission, asking that action be taken on his application for a license which has been pending since March, 1922, or that he be permitted to present arguments in behalf of the application. A few days later, the Governor of Arizona wrote to the commission, requesting a conference between that body and a committee of Arizona citizens on the Girand application and the Colorado River problem in general.

In view of these requests, the commission has notified Mr. Girand to appear before that body on Sept. 24, and the Governor of Arizona has been notified that a committee of citizens or officials from his state will be received on the same date. That all interests may be represented, the commission has invited the governors of Colorado, Wyoming, Utah, New Mexico, Nevada, and California to send representatives to this hearing.

The proposed convention for use of the Colorado River waters has been ratified by all the states excepting Arizona and has been advocated earnestly by Herbert Hoover, Secretary of Commerce, as a means of obtaining maximum development in that valley.

An interesting angle of the situation is that the Arizona state permit held by Mr. Girand, which was granted as the last act of Water Commissioner Norviel, will expire Dec. 31 by default if work is not started under its terms, and it is generally believed that, owing to a change in state administration, he would experience considerable difficulty in securing a renewal. But he cannot proceed under the state permit without a license from the Federal Power Commission, which has withheld action on his application for a year and a half pending the outcome of the compact among the states.

News from Mining Districts

By Special Correspondents in the Field

London Letter

Minerals Separation Coal Process Seems O. K.—Tin Market Up; Concessions Withdrawn

BY W. A. DOMAN

London, Aug. 23—From the standpoint of variety, there are probably more mines in Great Britain than in any other country in the world. The requirements for qualification of engineers are high. It is now officially announced that an examination for first- and second-class certificates of competency as managers and undermanagers of mines is to be held in half a dozen centers in November next. It was not until the war revealed a shortage of metals that the riches of this country were really known. The information was available, but it was all pigeon-holed, and it was largely due to the activities of the Imperial Mineral Resources Bureau, with Sir Richard Redmayne and Hugh F. Marriott to the front, that valuable reports saw the light of day.

A study of the report of the directors of Minerals Separation, Ltd., for 1922, just issued, shows that the activities of the company were mainly in two directions—coal and metals. Large plants for coal cleaning and briqueting, and for the new ore-reduction process are not yet in operation, and as relatively little has been done in the metal industries, expenditure exceeded income by £18,812. The briqueting plant apparently fulfills all that is claimed for it, and is working successfully at Nantes, in France, by the French company of Powell Duffryn; in Spain; and in South Wales. On a previous occasion I mentioned the arrangement with the Bwana M'Kubwa Copper Co., and results of the trial are expected soon. As regards the recovery of gold, a process is being tried at the Modderfontein Deep Levels, and before the current year is out these results should be made known. If successful, the mines of the Rand offer great scope.

The price of tin is on the up grade again, and at the moment is quoted at £190. This compares with £230 in the middle of March last. There appears to be a good deal of buying of the metal for the Continent of Europe. Naturally, the shares of tin mining companies in Nigeria should benefit. During the dull period economies were introduced right and left, and there seems a possibility of profits being earned again and dividends paid. While business was dislocated the Nigerian companies were granted important concessions, particularly as regards the royalty payable to the government, when the price of the metal was less than £180 per ton. Now that the market is advancing, the Nigerian Government has withdrawn these concessions.

Owing to the existing depression, the works of the Cape Copper Co. at Swansea (Wales) have lain idle for some time. Hopes that matters will improve have given rise to rumors of a new company is to be formed to acquire these works, and Sir Alfred Mond has been mentioned as connected with it. This gentleman has entirely dissociated himself from the matter.

Johannesburg Letter

Premier Felicitates Engineers — Rhodesion Broken Hill Erects Concentrator—Vaal Dam Completed

BY JOHN WATSON

Johannesburg, July 31—The Chemical, Metallurgical and Mining Society held its annual dinner on July 21, in the Scientific and Technical club house. The new president, F. W. Watson, was chairman. H. O. Buckle, president of the Chamber of Mines, said the foundation of the mining industry, upon which South Africa lived, was the knowledge, skill, and enterprise of the technical men of the industry. Prime Minister Smuts as the principal guest said that nothing opened the eyes of South Africans more to the fact that mining was the key industry of this country (and would be five or ten years hence) than the little strike of last year. Societies, such as were associated under the roof of their club house, were doing a great work in the development of the country for years to come.

The Rhodesian Broken Hill Co. recently increased its capital and is now installing a concentrating plant of 250 tons per day capacity. It is also about to install a large hydro-electric power plant for utilizing the water of the Mulungushi River, at a point about 14 miles east from Broken Hill. The company is operating extensive deposits of lead, zinc, and vanadium ores.

The discovery of a deposit of platinum is reported, this time, in the vicinity of Naboomsprint, North Transvaal. Two independent assays are said to have given results of 46 oz. to the ton. Prospecting is being actively carried on and options are being secured.

The Vaal River Barrage works of the Rand Water Board were formally opened by the Governor-General on July 27. The barrage has taken six years to construct and has cost over £1,500,000. Ultimately, it should provide a permanent supply of 2,000,000 gal. per day.

An analysis showing the distribution of South African gold, sold in London, published by *The Times* last week, shows that India was the largest buyer, having taken during the first six months of this year, £12,751,000, or nearly 60 per cent of the total shipments. More than 25 per cent, or £5,500,000, went to New York during the same period.

Consolidated M. & S. Co. Concentrator Ready to Start

THE 2,500-ton concentrator of the Consolidated Mining & Smelting Co. at Kimberley, B. C., has been completed and is ready to begin operation. The plant covers twelve acres of ground and is designed to treat 2,500 ton daily, and the cost of the installation was $1,500,000. The total investment of the company in mine and mill is reported to be $4,500,000. The orebody being mined is of great length and between walls is 180 ft. wide. The equipment is designed to facilitate work on a large scale. Two trains of mine cars can be loaded from the ore chutes in five minutes.

Melbourne Letter

Gold in New Guinea—Two Tin Properties Will Be Equipped With Dredges

BY PETER G. TAIT

Melbourne, July 31—The Waria River Co., which was formed in Melbourne to send a prospecting party to report on certain leases in former German New Guinea that did not realize anticipations, is interested in a new field in the same territory. B. V. Barton, leader of the expedition, is to return to New Guinea immediately to inspect another area which, according to reports, is phenomenally rich. Some beautiful samples of alluvial gold are on view in Melbourne, and a new company, Kaili Gold Options, has been formed to manage the proposed enterprise.

Several parcels of osmiridium of fairly good grade have recently been received from Papua. The metal is not so sharp as the Tasmania product, and it carries a percentage of platinum with it. Good prices are at present being obtained, and this will doubtless encourage the search for the metal in both countries.

The Austral Malay, which is interested so largely in tin dredging ventures in the Federated Malay States, has floated another company, the Thabawleik Tin Dredging Co., in Lower Burma, and it is to be immediately equipped with a large modern bucket dredge. This will probably be built in Austrila, but no contract has yet been placed.

Trang Consolidated Tin, Ltd., is being floated to work an alluvial tin area in Siam. An Australian engineer, A. J. King, of the Nawng Pet Co., also in Siam, has reported favorably on the property. The Powell elevator, which has done good work at Nawng Pet, will be installed in place of a dredge. Mr. King estimates that a single elevator will treat 1,080,000 yd. in 300 days at a mine cost of £7,200 and show a profit of £42,800 per annum.

ONTARIO

Kirkland Lake Mill Heads Averaged $14.14 for Half Year

During the month of July, the Lake Shore Mines, of Kirkland, produced $22,622 from 1,100 tons of ore, an average recovery of $20 per ton. The mill ran only 63.3 per cent of the possible running time, due, in a large measure, to the installation of a new hoist and headframe. Production at the present time is running at the rate of approximately $50,000.

An error has apparently occurred in the surveys of either the Lake Shore or the Teck-Hughes, as the former company has recently broken into the Teck-Hughes workings.

During the first six months of the present year there has been a substantial increase in the output of the Kirkland Lake district, and production from that camp amounted to 20 per cent of the total gold production of the province, as compared with 10 per cent for the corresponding period of 1922. This is due largely to increased grade of ore, the average for Kirkland being $14.14, against $8.22 for Porcupine. This compares with an average of $11.28 for Kirkland in 1922 and $8.95 for Porcupine. The Teck-Hughes had a higher grade than any other mine in the province, the average being $30.11 for the six months.

BRITISH COLUMBIA

Granby Drops Two, Takes Another

The Granby Consolidated has relinquished its option on the George Copper group, at the head of Bear River, and on the Sunshine group, on Glacier Creek, and it has taken an option on the property staked recently on the west branch of Texas Creek by Joe Jackson and Henry Hummel. On this property an 8-ft. vein is said to have been traced for 7,500 ft., and to be well mineralized at several points with fine-grained galena, giving an average assay of $75 per ton in silver and lead.

Bonds Yankee Girl

J. M. Iles, of London, has bonded the Yankee Girl mine, at Ymir, in the Nelson division, and proposes to float a company in London to operate it. Arrangements have been made with R. H. Stewart, of Vancouver, to act as consulting engineer for the company. The Yankee Girl has produced more than $500,000 worth of gold. It was closed in the general slump of 1920 and has not been reopened since.

Large Low-grade Gold Deposit

John D. Galloway, provincial engineer for the Omineca district, will make report on the low-grade gold-ore deposit which is being developed by Ontario interests on Selwyn Mountain, at the confluence of the Finlay and Parsnip rivers, in the Peace River region. It is stated that a "belt of ore" half a mile in width has been traced for two miles. Last year a small Ross mill was freighted in to the property, and a two-weeks' test is said to have given a return of $6.50 per ton. A larger mill has been taken to the property this season, and it is the intention of the owners to crush several hundred tons.

Tarzen Prospect Bonded

The New Age Mining Co. was recently organized in Nelson, B. C., to work the gold-silver property formerly owned by Tarzen brothers. The capitalization of the new company is $500,000. The property has recently been examined by W. Watson, a London mining engineer, who reported optimistically on the merits of the showing.

Anaconda Will Enlarge Wire Mill at Great Falls

SPECIFICATIONS for an addition to the Anaconda company's wire mill at Great Falls, Mont., have been sent out; bids are asked for erecting and equipping it. The present building has become too small to handle the output. With the new addition the building will be 125 by 500 ft. The estimated output of the wire mill for this August is 10,000,000 lb. of rod copper and 5,000,000 lb. of wire.

The building will be covered with zinc shingles, one of the company's newest products.

ALASKA

Placer Miners Suffer for Want of Water

Interior Alaska is experiencing one of the driest seasons on record, with the result that most of the placer miners are seriously hampered by shortage of water. Forest fires have been frequent, and in some instances camps and equipment have been destroyed. In the Livengood district of the Tolovana, eighteen outfits are placering, a crew of about 100 men being employed in actual operations. This work is divided between summer drift mining and open-cutting with hydraulic methods. Work there is practically at a standstill now, for everyone is busy fighting forest fires or watching for rain. Unless this camp gets some heavy fall rains the output for the season will be small.

MANITOBA

Increase Mill Capacity at Rice Lake

The Lake Superior Metals Co., in which Pittsburgh capitalists are largely interested, and controlling the Gold Pan and Pendennis mines, in the Rice Lake district, plans to increase the capacity of the Gold Pan mill from 16 tons to 50 tons per day, and to build a 50-ton mill at the Pendennis. Boyd H. Dodson, of Pittsburgh, a director of the company, recently visited the property.

MEXICO

Oaxaca Now Producing Mica on Small Scale

Señor Gonzalo Collada is producing mica from his mine in Etla, State of Oaxaca, Mexico. Shipments are made in small lots of from 50 to 100 kg. This is the only active property in the state, although the officials believe that with active exploitation a fair-sized and profitable industry could be built up.

According to the Secrataria de Industria Comercio y Trabajo, mica occurs in abundant quantities in many parts of the state, principally in the districts of Etla, Ejutla, Zimatlan and Miahuatlan, and in lesser quantity in the Isthmus of Tehuantepec. Up to the present there has been no systematic exploitation or development of the deposits of this mineral, the work being limited to the extraction of small quantities from the surface with no investigation in depth.

Most of the mineral produced so far has been of inferior class, dark and iron stained. There are undoubtedly zones that contain clear mica of good size, as in the region of Las Sedas, district of Etla, where some natives found blocks 15 by 18 in. that serve as windows.

Real del Monte Bonds Old Mine

It is reported the Real del Monte Mining Co. has taken an eighteen-month option on the Zitonga properties situated in the districts of Taxco and Zacualpan. The mines are near the village of Pregones in the State of Guerrero. The vein on the property is said to extend in some places to a width of over 20 ft. with an average value in the ores of 20 oz. silver per ton. In parts it narrows but the ore is richer. In the event the Real del Monte company makes the purchase, the sum of 900,000 pesos is to be paid to the present owners. A road will be built from Cacahuamilpa through the mining district of Taxco to Pregones.

Claims Forfeited by Decree

The following mining properties were declared forfeited by the mining department of industry during the month of July:

Baja California — Iron Giant, at Ensenada; Iron Giantess, Ensenada; Iron Duke, San Quintin.

Michoacan — La Redentora, at Arteaga.

Sinaloa — Buena Ventura, Rosario; Ampliacion de Purisima, Rosario; Colombus, Mazatlan.

Sonora—Maria, San Javier; Grandote, San Javier; El Voladero, San Javier.

Zacatecas—La Fortuna, Concepcion del Oro; San Pablo, Chalchihuites.

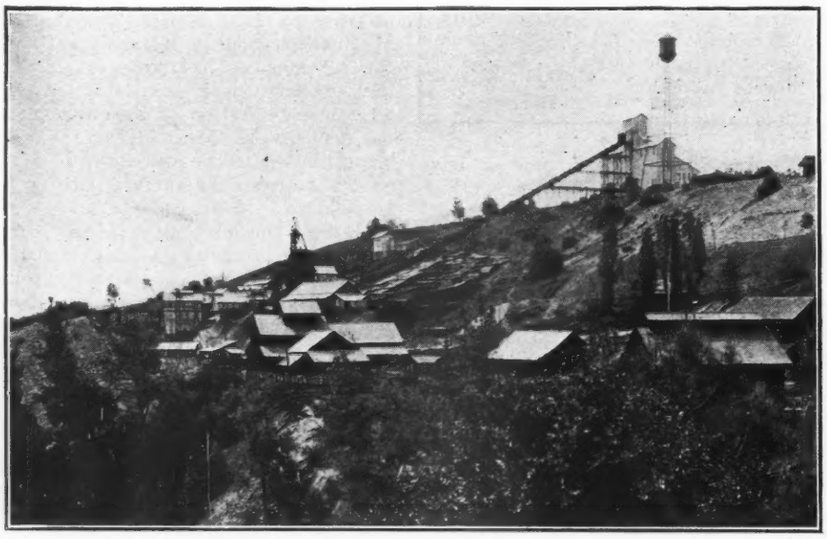
Owing to a recent decree by the President, concessions have been granted to the miners extending time for payment of overdue taxes. It is probable that very few, if any, claims will be forfeited during the nex few months.

CALIFORNIA

Mother Lode Mines Busy

Special San Francisco Correspondence

The Kennedy mine has finished shaft sinking and is now opening a station at the 4,200 level. Forty stamps are being operated. A new compressor, direct-connected to a 350-hp. motor, has just been installed. The Argonaut is operating 40 stamps. The Central Eureka is extending a raise from the 4,250 to the 4,100 level preparatory to stoping the orebody opened up on this level. An average of 30 stamps is being operated.



The Argonaut shaft on the Mother Lode at Jackson, Calif.

At Carson Hill, 500 tons of ore is being milled per day. In the new development a "flat vein" was followed down from the 675 level to the 825 level, and at this level the ore "petered" out. The seam was drifted upon and widened out to 14 ft. of ore of excellent grade. The maximum vertical depth of the mine is now 3,190 ft. The shaft will be sunk to the 4,250 level. A crosscut driven from the 4,125 level cut the vein, which was 16 ft. in width and of good grade ore. No drifting will be done until the 4,250 level is reached. The Calaveras, one of the company's properties, is also being worked. The ore is low grade but yields a profit. Working costs have increased and less trouble is being experienced with labor. Carson Hill will make a gross production of about $1,000,000 during 1923.

New Ore Developed at Plymouth

A new oreshoot has been developed recently below the 3,400 level of the Plymouth mine, according to W. J. Loring. The top of the oreshoot was discovered at a vertical depth of 3,726 ft. and it has been followed down by a winze to a vertical depth of 4,046 ft. or 320 ft. The oreshoot is 256 ft. long and averages 8 ft. in width and over $10 per ton. Sinking of the winze is being continued and winze levels have been established at 3,655, 3,850, 3,925, and 4,000 ft. points. The main working shaft of the property terminates at the 3,400 level. Loring has recommended the expenditure of sufficient funds to sink the Plymouth shaft deep enough to get below the new oreshoot.

WASHINGTON

Chloride Queen Will Ship

The Chloride Queen mine, near Colville, is getting ready to ship ore. The property has been undergoing development for several years but no ore has been shipped to date. Work is concentrated on a raise started 700 ft. from the portal of the lower tunnel.

75 Per Cent Lead Ore in Gladstone

The Gladstone Mountain mine near Northport has encountered ore in the No. 1 chimney on the 200 level having the usual high-grade assays—75 per cent lead. Shipments will go forward as usual but in greater quantity.

Two New Shippers to Bunker Hill

The Addison Copper Co. has sent its first shipment to the Bunker Hill smelter. The Iron Creek mine in the same district has started hauling ore to the railroad for shipment to smelter.

Black Rock Ore Goes to Trail

The Black Rock mine is making regular shipments of high-grade zinc ore to the Trail smelter. The mine is situated six miles east of Northport.

UTAH

Strike at the Iron Blossom Mine at Eureka

The Iron Blossom management reports a strike on the 400 level, by a lessee, operating through the No. 1 shaft. The find is in new ground, a short distance to the east of the old ore channel; the ore has been followed for 20 ft. It carries gold, silver, and copper and is stated to assay about $100 a ton. In general, work is progressing satisfactorily at this property, which is operating under the leasing system. Regular shipments are being made.

California Quicksilver Mine Celebrates 100th Anniversary

THE New Almaden Quicksilver Co.'s El Senador mine, on the extreme northwestern end of the company's property in Santa Clara County, Calif., is being successfully worked under lease and is producing from 250 to 350 flasks per month, or at the rate of approximately 3,600 flasks per annum. On Sept. 1, 1923, a barbecue was given at the hacienda at New Almaden by G. H. Sexton, president of the company, in celebration of the 100th anniversary of the mine.

COLORADO

Cresson Sinks Shaft an Additional 125-Ft. Lift

Sinking of an additional lift of 125 ft. from the 17th level of the Cresson mine, at Cripple Creek, which has been in progress the last three months, was completed Sept. 1. In addition to sinking to the 18th level, a 90-ft. sump has been driven to facilitate handling the water, which, on account of the excessive rains this summer, has been unusually troublesome in the lower workings of most of the mines in the district.

The preliminary station has been cut at the 18th level, and a crosscut is now being driven to the Cresson orebodies, which will connect with a winze sunk on the ore measures from the 17th level. A new boiler recently has been installed, and a rope tram is being constructed to bring coal from the railroad, which is now hauled by team. The Cresson is producing approximately 10,000 tons monthly, of an average value of $14. A labor shortage, especially of machine men, has retarded operations on this property, as well as at many others in the camp.

Increased activities in operating mines and the resumption of work at old properties foreshadow an increase of several hundred miners before the end of the year, if they can be obtained.

IDAHO

Concentrator for Hewer Mine

A body of commercial ore 25 ft. wide has recently been uncovered in the Hewer mine, in the Lakeview district, in driving a crosscut. The Hewer Mining Co. is erecting a 50-ton concentrator on the property, on which it has developed ore in a 10-ft. vein carrying an average of 2 per cent lead and 15 oz. of silver per ton.

Rich Ore Near Priest River

Ed. Waterman, of Priest River, recently discovered a vein 8 ft. wide carrying 50 per cent lead and 75 oz. silver. According to reports the find is the best surface showing made in northern Idaho in years.

Fifty-Hour Trip Now Made in Fifty Minutes by Airplane

AIRPLANE transportation is now a reality in the interior of Alaska. A company organized as the Farthest North Airplane Co., with headquarters in Fairbanks, has had one small plane in operation during the summer and will probably add one or two more planes for next season. The plane is in charge of C. B. Eielson, an experienced flier, formerly in the army air service. It is being well patronized by mining men, and trips have been made to the upper Salachaket country and to the Tolovana. The first flight was made from Fairbanks to Livengood in 50 minutes, which stands as an interesting contrast with the time of 50 hours generally required for the trail trip between the two camps. In other words, hours are traded for minutes when the air is used for a track.

NEVADA

Lucky Boy Changes Hands

The Hawthorne Mines Co. has been incorporated by John H. Miller and associates to take over and operate the Lucky Boy mine, near Hawthorne, Mineral County. The mine has been a famous producer of silver-lead ore and is said to contain a large amount of mill ore that can be treated by flotation.

Bellehelen Cuts Output

The Wellington Mines Co., which built the 50-ton cyanide mill at the Bellehelen Merger mine, 48 miles east of Tonopah, has restricted the output and decreased the mine force. Sinking has been resumed in the winze 100 ft. below the tunnel level.

Tonopah Bullion Shipments

The following bullion shipments from Tonopah representing clean-ups for the first half of August have been dispatched, their approximate value being: Tonopah Extension, 47 bars, 87,630 oz. $69,500; West End, 24 bars, 51,700 oz. $43,945; White Caps, refinery slag $5,248; bar bullion $11,360, total $16,608; Tonopah Mining, 16 bars, 22,000 oz., $17,600; total $147,653.

New Finds at Cherry Creek and Comet

Strikes of good ore were reported last week from the Comet district and the Cherry Creek district near Sharp. These strikes have been the first for some time to create interest in Pioche. The ore from the Cherry Creek strike is silver-lead and the outcrop has been traced for the length of two claims. Selected samples assay 420 oz. silver. The ore struck in the Comet district was at a depth of 100 ft. in the Lyndon mine, the first shipping ore to be found below the tunnel level.

Pioche Shipments Increase

Shipments have again increased from the Pioche district due to the resumption of work at Bullionville, five cars of tailings now being sent forward daily to the Garfield plant of the A. S. & R. Co. under a new rate on siliceous ores. Shipments from the Virginia Louise Development Co. are now averaging about 4 cars of fluxing ore daily, the product being shipped to all three Valley smelters. Development work continues at the Combined Metals mine, and such ore as is taken out in development work is shipped. Last week 150 tons were sent to the River Smelting Co. at Florence, Colo.

JOPLIN-MIAMI DISTRICT

New Mill for Tulsa-Quapaw

The Tulsa-Quapaw Mining Co. is erecting a new concentrator on the old Playter lease, southwest of Treece, Kan., and northwest of Picher, Okla. The mill frame is about completed, and machinery is being installed. Three oil engines will be used, one of which is now in operation in the work of sinking the two shafts. The lease, consisting of 40 acres, has been worked by two other companies, but the Tulsa-Quapaw people have struck several rich drill holes since they took it over.

Anna Beaver Gets Rich Run of Ore

The Anna Beaver Mining Co., a subsidiary of the Metals Exploration Co., which has been doing extensive drilling on its acreage near Tar River, Okla., has recently encountered rich ore in two of its field shafts. In one the formation is the familiar water-course or mineralized cave, so frequently found in this field, and is declared particularly rich. The company now has four field shafts, virtually all of the dirt being taken out being handled at the No. 2 mill. Lee Filius, local manager, recently put a drill at work on the northeastern portion of the lease and hopes to tap an ore run that has been mined successfully by the Dorothy Bill mine in that vicinity.

Gets Water and Resumes

The White Mining Co. has resumed operations after being down since July 7. The property was closed in the first place to help along the curtailment program, but when it wanted to reopen it found it lacked sufficient water. Recently it made arrangements to pump water a mile and a half from the pond of the Eagle-Picher's Goodwin mine, which in turn gets its water from its Bendelari mine, about a mile and a half distant.

Concentrator Burns

The S. R. & S. concentrator, in the northwestern part of Picher, was completely destroyed by fire of unknown origin recently. The loss was estimated at $90,000, partly covered by insurance. It was owned by Sparks and Rains, of Galena, and probably will be rebuilt.

Unusual Plan Guarantees Return of Investment in Mine Shares

THE Abitibi Mines, Ltd., of Canada has adopted a new plan of mining finance. Instead of selling stock at a heavy discount it will sell the shares at par value of $1 each and give the purchaser a bond of a well-known trust corporation guaranteeing the return at the end of fifteen years of the full amount subscribed, with 3 per cent interest. This arrangement is made possible by depositing with the trust corporation a sufficient amount of money to comprise a sinking fund, which on a compound interest accruing basis will repay the principal together with 3 per cent interest in fifteen years and leave sufficient working capital for development. Apparently about $400 will have to be raised for every $100 available for financing operations.

MICHIGAN

North Kearsarge Could Produce on Short Notice

Probably the first of the idle mines of the Calumet & Hecla group to be reopened with the expected consummation of the proposed merger will be the North Kearsarge branch of Osceola Consolidated. All three shafts are in good condition and mining can be resumed on short notice. Repairs have been made from time to time as needed, and the mine has been kept free of water by electric pumps. No mining has been done at this branch since the fall of 1920.

The quality of the rock was unusually good when operations ceased. The average yield was approximately 16 lb. per ton, but under present methods of selective mining this return could be appreciably increased as has been done in case of Isle Royale. Ground developed in the 36th level drift, south, in No. 1 shaft is particularly good. There also are stretches of high-grade rock in the 37th and 38th levels, north and south. Storage-battery locomotives have been operated successfully in this branch and have partially solved the trammer-shortage problem, effecting also a considerable saving in costs. The inflow of water from the Wolverine property, which formerly gave considerable trouble, is now adequately handled by the installation of electric pumps.

Seneca Surface Plant Ready

Seneca, in the copper district, is about ready to start regular production, but the definite date has not yet been announced. The new steel rockhouse and shafthouse at No. 1 Gratiot shaft is practically completed, and at Senaca shaft the hoist will be ready in a week or ten days.

The Situation at the Mines

By Arthur B. Parsons
Assistant Editor

"HOPEFUL" is about the most appropriate word that can be used to describe the situation in most metal-mining districts. The rate of copper production in the aggregate still is climbing slowly, although there has been a falling off in the output of some individual companies and a few shutdowns are to be noted among the smaller companies, both producers and non-producers. On the other hand, the Calaveras Copper Co. and the Mountain Copper Co., in California, have just started production. Judging from the steady increase in the rates of output of the "low-cost" companies, there is no notion of curtailing in an effort to help the market. Utah Copper, for example, is shipping close to 40,000 tons of ore per day for a metal output of nearly 20,000,000 lb. monthly. Apparently each enterprise is to be left to stand on its own feet. If it cannot make money on the current market it can take its choice between shutting down—a proceeding that has proved very expensive indeed—and continuing to operate for the time being at a loss. The small high-cost companies are finding the going very rough at the prevailing 13½c. market; the larger companies in the high-cost group are strongly financed and can weather a period of low market prices more easily. The general superintendent of one of the largest of these companies declared recently that he had "quit guessing and was merely hoping." So far as mine operations are concerned, the policy today is to go ahead and make as much copper as possible, as economically as possible. In Michigan and Arizona, and to a less extent in Montana, output would be increased if a greater number of competent miners could be obtained *at present wages*. Output could be increased if wages were raised materially; the present scale represents what the companies consider the economic maximum with the current copper market.

Zinc Production on Five-day Basis at Joplin

Zinc production is still on a curtailed basis. The Joplin-Miami district is making about 9,500 tons of concentrate weekly, compared with a maximum of nearly 13,000 during the early part of the year. At Butte a current output of 14,000,000 lb. of metal—in concentrate—compares with 19,000,000 two months ago. Last July in Joplin a concerted shutdown for two weeks was followed by an agreement to operate on a five-day-per-week basis; this is still in effect. It is problematical how much this has had to do with the improvement in the market from 5¾ to 6⅝c., the present quotation. Operators hope for still further advances so as to warrant increased output, but few expect really high prices.

Domestic production of lead ore is at a somewhat lower rate than prevailed before the completion of the Pittman Act purchases early in June. The generally prevalent association of lead and silver in the same ore naturally increased the output of lead when silver mining was subject to abnormal stimulation. The decrease in smelter output of course lagged behind mine output a couple of months, so that there may be some significance in the slight improvement in the lead market, which increased from 6¼ to 6⅜c. during last month. As a matter of fact lead-mine managers are well satisfied with the situation, and, in general, are operating at maximum capacity.

Silver Mining Not Active

Silver mining in the United States is naturally pretty dull so far as the "primarily" silver properties are concerned. Tonopah production, for example, is only about half of maximum, but it may pick up slightly. At any rate the companies have settled down and are able to do more systematic mining than during the life of the Pittman Act. Silver mining in Ontario continues to flourish; it escaped the dislocation of last June.

California mine production, except for copper, is less than last year at this time. Lode gold mining appears to be holding its own, whereas placer output has diminished.

Much Construction Work Under Way

A feature of the industry in Arizona is the major construction work that is under way. Phelps Dodge is increasing the capacity of its No. 6 concentrator at Clifton to 4,500 tons; Calumet and Aizona is improving the smelter at Douglas; New Cornelia's $4,000,000 flotation plant is progressing; United Verde is building a huge crushing plant; Magma is rushing work on its new copper smelter; Old Dominion has just finished enlarging its mill; and a new $2,000,000 dam and hydro-electric project is under way in the Salt River Valley. These are tangible evidence of the "hopefulness" of the copper industry.

Utah lead smelters are operating at diminished capacity as a consequence of the falling off in current mine shipments and the exhaustion of the excess stocks that accumulated early in the summer. The Garfield smelter, on the other hand, has started its fourth copper reverberatory.

Coeur d'Alene, Idaho, lead production has been decreased by the shutting down of the Hecla following the disastrous fire. The company is to be congratulated for the rapidity with which reconstruction is progressing.

In Montana miners are beginning to return to Butte from outlying districts and from work in sundry other industries. This is expected to relieve the labor stringency to some extent. Anaconda's copper output is around 18,000,000 lb. per month.

Colorado seems to be slowly waking up, and production statistics show some improvement over last year in the San Juan, Telluride, Cripple Creek, and several small northern districts. Leadville ore shipments have fallen off because of lower silver market and burdensome changes in smelter schedules on siliceous ore.

In the Joplin-Miami district a serious drought has shut down some operations. On the other hand, several new and remodeled mills have recently been started. The labor situation is satisfactory on the present production basis.

Michigan copper output for August was 11,600 lb., just 50 per cent of the pre-war average. Small net gains in the number of miners are reported.

Iron Outlook Good

In the Lake Superior iron-mining region shipments for August aggregated more than 10,000,000 tons, close to the record of July, 1918. Producers are optimistic as to the outlook for 1924, which means an active winter for underground operations. The present shortage of labor will doubtless persist until November, when most of the open-pit operations will be suspended for the season. Work is under way to double the capacity of the Mesabi Iron Co.'s plant at Babbitt, Minn.

The blowing in of a second furnace by the British America Nickel Co. and important improvements at the other nickel smelters at Sudbury indicate a healthy condition for Ontario's nickel-mining industry. The gold and silver districts likewise are thriving. Companies that are producing are breaking records and those that are prospecting or developing are finding enough to keep their hopes high.

The Consolidated M. & S. Co. started its new 2,000-ton concentrator at Kimberley, in British Columbia, on Aug. 22. The province is the scene of development by strong companies. The Federal M. & S. Co. and the Grandy Consolidated are each actively engaged at a number of properties under bond. The abandonment of several options in the Portland canal district by a London syndicate is ascribed to the exaggerated ideas entertained by the owners as to the value of meagerly developed properties.

THE MARKET REPORT

Daily Prices of Metals

Aug.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
30	13.375	40.375	40.875	6.80	6.65	6.425
31	13.375	40.00	40.50	6.80	6.65	6.425
Sep. 1	13.375	40.50	41.00	6.80	6.65	6.45
3	.....	.....	.....	....	...	....
4	13.375@13.50	40.875	41.375	6.80	6.65@6.70	6.45@6.50
5	13.50	40.875	41.375	6.80	6.65@6.70	6.55
Av.	13.413	40.525	41.025	6.80	6.660	6.465

*These prices correspond to the following quotations for copper delivered: Aug. 30th, 31st and Sept. 1st, 13.625c.; 4th, 13.625@13.75c.; 5th, 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
30	62 7/8	63 5/8	68 1/2	193 7/8	195	24 3/4	24 3/4	33 1/2	32 3/8
31	62 5/8	63 3/8	68	191 3/4	193	24 3/4	24 7/8	33 1/2	32 1/4
Sept. 3	63 3/8	64 1/4	68 1/2	194 3/4	195 3/4	25 1/8	24 7/8	33	32 1/2
4	64 1/4	65	69	197 1/4	198 1/4	25 1/2	25	33 5/8	33 1/4
5	64 1/4	65	69 1/4	198	199	25 7/8	25 5/8	33 3/4	33 3/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
30	4.54 5/8	62 3/4	30 15/16	90s 7d	3	.....	...	30 15/16	90s 9d
31	4.54 5/16	62 3/4	30 15/16	90s 8d	4	4.53	63 1/8	31 1/16	90s 10d
Sep. 1	4.54 1/8	62 3/4	30 15/16	.....	5	4.50 5/8	63	31 1/4	91s 4d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for August

Copper:	
New York Electrolytic	13.822
London Standard	64.034
London Electrolytic	70.000
Lead:	
New York	6.582
St. Louis	6.496
London	24.222
Silver:	
New York, foreign	62.793
London	30.952
Sterling Exchange	455.714
Zinc:	
St. Louis	6.325
London	32.386
Tin:	
99 per cent	38.841
Straits	39.269
London	186.705
Antimony	7.753
Quicksilver	65.212
Platinum	116.000

Metal Markets

New York, Sept. 5, 1923

The Labor Day holiday on Monday seriously interfered with the metal business during the week, as practically every one included Saturday in the week-end vacation. With the coming of September, greater activity in the metal market is expected, and signs are already in evidence that it will come about. Copper inquiries are much better in the last two days, lead is distinctly firmer, zinc prices are increasing with export sales, and tin seems safely above the 40c. level.

Copper

Some bargain lots of copper were picked up on Thursday and Friday, and even as late as yesterday, at 13⅝c. delivered, though only a few sellers were willing to come to that level. With the advance in London, the inspiration of which we have not yet learned, unless it was attributable to the war scare, the market here was immediately stronger. There was less a tendency to cut prices, and more inquiry from consumers. Also, a good export business was done, mostly at 13.95@14c., c.i.f. European points. Germany, France, and England were important buyers. Yesterday morning several hundred tons were sold at 13⅝c., but in the afternoon 13.75c. was freely paid, and this latter price has also been paid today.

Lead

The official contract price for lead of the American Smelting & Refining Co. continues at 6.75c., New York.

Conditions have not changed much in the lead market, but the situation seems to be growing tighter gradually. Plenty of October lead can be obtained at the 6.75c. level, and a good tonnage has been sold during the week. September is much scarcer, however, and for early September delivery 7c. has been paid in a few instances. Dealers are also having great difficulty in securing lead for any delivery at less than 7c. In St. Louis, producers have been quoting 6.65c. all week for October deliveries to consumers, though there, as in the East, early deliveries are hard to get, and even 6.70c., Chicago, has been paid. Consumers are apparently finding their fall orders fully as large as expected, the demand for lead from cable manufacturers and mixed metal makers being particularly good. Corroders have also been in the market, and ammunition makers seem to be taking a little more lead than they have recently. A Greek exporter was an anxious inquirer for from 50 to 100 tons during the week.

Zinc

The price of slab zinc showed a healthy advance during the week, owing to the exhilarating effect of the rise in London. The principal activity in this country was in transactions among dealers. Galvanizers were not much in evidence in the market. The demand for English galvanized sheets by Japan

is held to be responsible for the advance in London. Today zinc was sold for 6.55c. per lb. whereas earlier in the week it could have been obtained as low as 6.40c.

High-grade metal is still selling for 8@8½c. per lb. New York quotations of ordinary grades are 35c. per 100 lb. above East St. Louis.

Tin

Buying has been in fair volume at the higher prices and there is nothing to indicate that they will not be maintained, as tin is gradually improving statistically. Business in the 99 per cent grade is confined to occasional small lots of Chinese tin and to remelted metal; quotations are nominal.

Tin arrivals during August, according to the New York Metal Exchange, were 6,360 long tons, divided as follows:

	August	Last Eight Months
Straits	4,770	34,385
Australian	15	345
Banka and Billiton	600	3,328
English	680	4,905
Chinese	245	4,649
Sundries	50	50
	6,360	47,662

On Sept. 1, 75 long tons arrived from London.

Foreign Exchange

On Tuesday, Sept. 4, cable quotations on francs were 5.6125c.; lire, 4,26c.; and Canadian dollars, 2 1/32 per cent discount.

Silver

Up to the Labor Day holiday prices in both London and New York held steady, although the market was quiet. After the Japanese disaster, all Far Eastern exchanges advanced, and the silver market here and abroad did likewise. The advance in New York, however, was not so marked on account of the break in sterling exchange.

Mexican Dollars—Aug. 30th, 47⅞; 31st, 47⅞; Sept. 1st, 47⅞; 4th, 48⅛; 5th, 48.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 26@27c. per lb.; 98 per cent, 25@26c. London, 98 per cent, £115 per long ton.

Antimony — Chinese and Japanese brands, 7½@7¾c. W. C. C., 8½c. Cookson's "C" grade, spot, 10¼@10½c. Chinese needle antimony, lump, nominal, 5.50c. per lb. Standard powdered needle antimony (200 mesh), 6@6.50c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.75@8.25c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 4s. 6d.

Cobalt—$3 per lb. for spot. Discounts on contracts. Oxide, $2.10@$2.25. London, 11s. for metal; 9s. for black oxide.

Iridium—$265@$300 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, $1.25 per lb. London quotes 3s. 3d. @4s. for 99 per cent.

[1]**Molybdenum**—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £125@£135.

Osmium—Pure, $70 per oz. troy, in Los Angeles. Nominal.

Palladium—$80 per oz. London,, £17 nominal.

Platinum—$116 per oz. London, £25 for manufactured; sponge, £23.

Quicksilver—$64 per 75-lb. flask. San Francisco wires $62.00. London, £8 10s.

Radium—$70 per mg. radium content.

Rhodium—$100@$105 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tellurium—$2 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $8 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 97c.@$1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Indian chrome ore, $21 per ton, c.i.f. Atlantic ports. Rhodesian, $22@23 and New Caledonian, $25.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5.25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—40c. per long ton ton unit, seaport, plus duty; chemical ore, plus 82 per cent MnO_2, $75@$80 per gross ton, powdered.

Molybdenum Ore—75c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, ¾@1c. per lb. for ore. Rutile, 94 per cent TiO_2, 10c. per lb. for car lots.

Tungsten Ore—Scheelite, $9.50@$10. Wolframite, $8.75@$9 per unit of WO_3 for high-grade ore. Chinese ore, $8.50.

[1]**Vanadium Ore**—75c.@$1 per lb. of V_2O_5.

Zircon—$50 per ton.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 1—Blende, per ton, high, $42.70; basis 60 per cent zinc, premium, $41; Prime Western, $39@$40; fines and slimes, $37@$38; average settling price, all zinc ores, $38.71.

Lead, high, $83.60; basis 80 per cent lead, $85; average settling price, all lead ores, $81.07 per ton.

Shipments for the week: Blende, 11,704; lead, 2,056 tons. Value, all ores the week, $619,660.

Purchases for future delivery of 11,210 tons of zinc ore were made today, approximately the tonnage produced and shipped. Buyers offered only $39 up to noon today, with sellers holding firm for $40 basis, which was agreed upon in mid-afternoon. The advance of $5 per ton in lead is an effort to procure some badly needed lead held in storage for higher prices than have been offered for two months past.

Platteville, Wis., Sept. 1,—Blende, basis 60 per cent zinc, $42 per ton. Lead, basis 80 per cent lead, $82 per ton. Shipments for the week: Blende, 415 tons; lead, none. Shipments for the year: Blende, 20,928; lead, 500 tons. Shipments for the week to separating plants, 653 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $375@$500; No. 2, $250@$300; spinning fibers, $150@$200; magnesia and compressed sheet fibers, $90@$135; shingle stock, $50@$65; paper stock, $35@$40; cement stock, $20@$25; floats, $8@$15—all per short ton, f.o.b. mines, Quebec.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Best demand in shorter fibers. Crudes experiencing competition from South Africa. Prices are low.

Barytes — Crude, $7@$10 per ton; market firm. Unbleached and bleached, $28@$30 per ton, f.o.b. St. Louis. Ground white, $15@$18; off-color, $12@$14.

Some decline in demand and a decrease in shipments has been asked by buyers.

Bauxite—American, crushed and dried, $5.50@$8.75 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, crushed, $20@$24 per gross ton, all f.o.b. shipping points.

Foreign red bauxite, French and Dalmatian, $5.50@$6.50 per metric ton according to grade; foreign white grades, $7.50@$8.50, c.i.f.

Beryl—4½c. per lb. f.o.b. Connecticut points.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 10½c.

Chalk—English, extra light, 5c. Domestic light, 4½@4½c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $6@$7; washed, $8@$9; powdered, $13@$20, f.o.b. Virginia points. Imported lump, $15@$20, f.o.b. American ports; powdered, $45@$50, f.o.b. New York. 1A grade, refined, $15 per ton, Delaware.

Diatomaceous Earth—Natural aggregate, $25 per ton; insulating powder, $45; filtration powder, $35; calcined aggregate, $45, f.o.b. plant, California. Market good.

Emery—Greek Naxos, 8c.; Turkish, 7c.; Khasia, 6c. per lb., f.o.b. factory. American, 4@5c., f.o.b. shipping points, packed in 350 lb. kegs. Prospects are for better demand. Market fair.

Feldspar—In Maine, No. 1 pottery grade, $19 per ton; market good. Grade 97 per cent pure offered at $10, f.o.b. quarry, water shipment.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

In Connecticut, No. 1 spar, $7 per ton; No. 2, $6.50. Pulverized, from $18@$20 for 160 to 180 mesh to $25 for 200 mesh.

In New York, No. 1 crude, $8 per ton. Market strong.

In North Carolina, No. 1 ground, 140 mesh, $15@$16 per ton. No. 2 ground, 90 to 100 mesh, $10 per ton. No. 1 (less than 10 per cent flint) $6.50@$7; No. 2 (about 25 per cent flint) $5@$6, f.o.b. railroad sidings. Market strong.

No. 1 Canadian ground, $20 per net ton; f.o.b. mill. Market good.

Fluorspar—95 per cent CaF_2, 3 per cent SiO_2, $20 per net ton, c.i.f. New York in bond. Washed gravel, 85 per cent and over calcuim fluoride, 5 per cent and under silica, $23.50 per ton, f.o.b. Ill.; acid lump, $40 per ton. Market quiet.

Fuller's Earth—16 to 60 mesh, $18 per ton; 16 to 30 mesh, $17; 30 to 60 mesh, $18; 60 to 100 mesh, $14.50; 100 mesh and finer, $7.50; f.o.b. Florida mines. Demand fair.

Garnet—Spanish grades $60 per short ton, f.o.b. port of entry. Domestic Adirondack grades, $85 per ton f.o.b. shipping points. Others, $75@$85.

Graphite—Ceylon lump, first quality, 5¾@6¼c. per lb.; chip, 4¾@5¼c.; dust 3½@4c.

Gypsum—Crushed rock, $3@$4.50 per ton. Ground, $3.50@$8.50, f.o.b. shipping points.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ½ in. and larger, $1.10 @$1.75 per net ton. Agricultural limestone, pulverized, $2.50@$4.50 per net ton, f.o.b. eastern shipping points.

Magnesite—Crude magnesite, $14 per ton; calcined $35@$37, f.o.b. shipping point in California. Market very good.

Dead-burned magnesite in sacks, $40 @$42, Chester, Pa.; in bulk, $32@$34, Chewelah, Wash.

Caustic calcined, Grecian, $51 c.i.f. New York.

Manjak—Barbados, in 1 to 5 ton lots, grade "C" lump, $330 per short ton; "C" fine, $250; grade "A," $185—all c.i.f. New York.

Mica—Domestic, No. 1 quality, 1½x2 in., 10c. per lb.; 2x2 in., 35c.; 2x3 in., 70c.; 3x3 in., $1.20; 3x4 in., $1.75; 3x5 in., $2.25; 4x6 in., $3.25; scrap, $25 per ton, North Carolina.

Scrap, $22 per ton; washer and disk, $8@$15 per ton, f.o.b. N. H. mill. Market good.

[1]Monazite—Minimum 6 per cent ThO_2, 6@8c. per lb.

Phosphate—77 to 76 per cent tricalcium phosphate, hard rock, $7.50 per ton, f.o.b. Jacksonville; 77 to 76 per cent pebble grades, $6.75; 75 to 74 per cent pebble, $5.75; 70 per cent pebble, $4.35; 66 to 68 per cent pebble, $3.90, f.o.b. Tampa.

In Tennessee, 65 per cent ground rock, $5.50@$6.50 per ton; 72 per cent washed, unground, $5.50@$6 per long ton; 75 per cent lump, free of fines, $6.50; 78 per cent, lump, $8@$8.50 per long ton. Market quiet.

Pumice Stone—Imported lump, 3@ 40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Imported lump, 1 in. diameter and up, 11½c. per long ton unit; furnace size, 2½ in. diameter, 12c. per long ton unit; fines, through ½-in. mesh, 11½c. per long ton unit; cinder property of buyer, ex ship, Atlantic ports. Ore contains 50@51 per cent sulphur; cinder about 63 per cent iron.

Silica—Glass sand, $1.50@$3 per ton. Market quiet; 500 mesh, $31; 350 mesh, $25; 200 mesh, $20; 100 mesh, $8; all f.o.b. Illinois plant, water ground and floated for paints and polishes.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Ground talc, 150 to 200 mesh, $6@$8 per ton, bags extra, Vermont. Prices weak; demand light; competition severe.

Roofing grades, $5@$7.50 per ton; paper grades, $9@$17; Vermont.

Coarse, $6.50; fine, $8@$14 per ton; crayons, $1.20@$2 per gross; Vermont.

White talc, $25 per ton; gray-white, $8; yellow, $9; red, $10; North Carolina.

Grade A, 350 mesh, $22; grade B, 300 mesh, $18; grade C, $12 per ton, f.o.b. New York. Double air-floated talc, 325 mesh, $14.75 per ton.

Tripoli—Once ground, rose and cream colored, $16@$25; white, $18@$27; double ground, r. and c., $17@$25; w., $19@$30; air-float, r. and c., $25@$30; w., $35; super air-float, r. and c., $35@ $40; w., $40@$45. All per short ton in 200-lb. burlap bags with paper liners, minimum car, 30 tons, f.o.b. Missouri.

Mineral Products

Arsenious Oxide (white arsenic)—10¼@10½c. per lb. delivered over balance of year.

Copper Sulphate—Current quotations, 5.25@5.45c. with freight allowed, for domestic material.

Sodium Nitrate—$2.45 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate—Basis 90 per cent, $43.67 per ton.

Sodium Sulphate—$26@$28 per ton, New York.

Ferro-Alloys

[1]Ferrocerium—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 28@30c. per lb.; 4 to 6 per cent carbon, 12c. per lb.

Ferromanganese—Domestic, 78@82 per cent, $117.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $45@$47.50, f.o.b. furnace; 16@19 per cent, $44@$46.50.

Ferromolybdenum—$2 per lb. of contained molybdenum for 50 to 55 per cent grades. Dull.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

Ferrosilicon—10 to 12 per cent, $43 @$50 per gross ton, f.o.b. works; 50 per cent, $85 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—85@95c. per lb. of contained W, f.o.b. works. Quiet.

[1]Ferro-uranium—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.50@$4.50 per lb. of V contained, f.o.b. works. Active.

Metal Products

Rolled Copper—Sheets, 22½c.; wire, 16½c.

Lead Sheets—Full lead sheets, 10.25c. per lb.; cut lead sheets, 10.50c. in quantity, mill lots.

Nickel Silver—28½c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 19½c. per lb.; rods, 16½c. per lb.

Zinc Sheets—9.25c. per 100 lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$50@$52 per net ton, f.o.b. shipping point.

Firebrick—First quality, $45@$48 per M., Ohio and Kentucky works; $45 @$48, Central Pennsylvania; second quality, $38@$42.

Magnesite Brick—9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$45@$47 per M., Pennsylvania; $53@$55 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

The Iron Trade

Pittsburgh, Sept. 4, 1923

Steel production has been at practically unchanged rate during the two midsummer months, at 2 or 3 per cent under the June rate and about 11 per cent under the peak rate, last April. Buying was lighter in August than in July and the trend was slightly downward during August.

Up to date, finished steel prices have been fully maintained at the level at the end of April, when advances had just ceased.

Consumption of steel continues heavy, with scarcely any decrease at any point. Car and locomotive buying is extremely light and structural steel awards are running rather low.

Pig Iron—Market prices continue firm at $26.50 for bessemer, $25 for basic, and $25 to $26 for foundry and malleable, f.o.b. Valley furnaces, with buying slightly increased but still light.

Connellsville Coke—Spot furnace, $5; September contracts, $4.75@$5; spot foundry, $5.50@$6. Demand for heating coke has increased.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1922	1923	1922	1923	1922	1923
January	65.450	65.668	35.035	31.928	421.750	465.053
February	65.290	64.313	33.891	30.875	435.511	468.631
March	64.440	67.556	33.269	32.310	436.912	469.269
April	66.575	66.855	34.080	32.346	440.715	465.220
May	71.154	67.043	36.023	32.611	444.106	462.252
June	71.149	64.861	35.900	31.611	444.615	461.132
July	70.245	63.015	35.644	30.942	444.165	458.025
August	69.417	62.793	34.957	30.952	446.069	455.714
September	69.515	.....	35.305	.....	442.800	.....
October	68.015	.....	34.498	.....	443.583	.....
November	65.177	.....	32.882	.....	447.484	.....
December	63.905	.....	31.383	.....	460.440	.....
Year	67.528		34.406		442.346	

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1922	1923	1922	1923	1922	1923
January	13.465	14.510	65.226	64.494	72.321	71.409
February	12.864	15.355	60.250	67.700	66.125	74.500
March	12.567	16.832	59.245	73.851	65.739	81.464
April	12.573	16.663	58.799	73.169	64.028	81.331
May	13.111	15.440	61.092	67.460	66.554	76.568
June	13.575	14.663	61.988	66.607	69.333	73.238
July	13.654	14.321	63.137	65.278	70.321	72.364
August	13.723	13.822	63.784	64.034	69.932	70.000
September	13.748	.....	63.113	.....	70.917	.....
October	13.632	.....	62.773	.....	70.693	.....
November	13.598	.....	62.795	.....	70.216	.....
December	14.074	.....	63.267	.....	70.132	.....
Year	13.382		62.123		68.859	

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1922	1923	1922	1923	1922	1923
January	4.700	7.633	4.388	7.571	23.667	27.119
February	4.700	8.050	4.396	8.093	20.681	28.519
March	4.720	8.252	4.421	8.254	21.266	28.815
April	5.115	8.101	4.946	7.996	22.993	26.956
May	5.420	7.306	5.281	7.085	24.462	25.614
June	5.745	7.146	5.563	6.852	24.685	25.429
July	5.729	6.237	5.447	6.126	24.869	24.188
August	5.824	6.582	5.537	6.496	24.580	24.222
September	6.110	.....	5.868	.....	24.131	.....
October	6.530	.....	6.338	.....	25.551	.....
November	7.047	.....	6.868	.....	26.199	.....
December	7.163	.....	6.978	.....	26.079	.....
Year	5.734		5.503		24.097	

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1922	1923	1922	1923	1922	1923
January	31.480	37.986	32.100	39.173	163.065	181.852
February	29.835	40.693	30.767	42.011	149.850	190.513
March	28.426	46.569	29.171	48.569	143.152	219.607
April	29.810	44.280	30.605	45.810	149.840	213.081
May	30.149	42.346	30.971	43.135	150.163	203.097
June	30.707	40.375	31.497	40.957	152.512	191.798
July	31.025	37.970	31.733	38.490	156.149	181.188
August	32.134	38.841	32.380	39.269	160.006	186.705
September	32.075	.....	32.395	.....	160.065	.....
October	33.935	.....	34.600	.....	170.563	.....
November	35.911	.....	36.734	.....	179.341	.....
December	36.480	.....	37.695	.....	178.697	.....
Year	31.831		32.554		159.450	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1922	1923	1922	1923
January	4.691	6.815	26.321	35.733
February	4.485	7.152	24.213	35.613
March	4.658	7.706	25.467	36.720
April	4.906	7.197	26.576	34.275
May	5.110	6.625	27.304	31.057
June	5.346	6.031	27.893	29.548
July	5.694	6.089	29.042	29.335
August	6.212	6.325	31.170	32.386
September	6.548	.....	31.750	.....
October	6.840	.....	34.528	.....
November	7.104	.....	38.011	.....
December	6.999	.....	37.757	.....
Year	5.716		30.003	

St. Louis quotations, cents per pound. London, pounds sterling, per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1922	1923	1922	1923	1922	1923
January	4.463	6.884	49.960	72.731	97.260	112.462
February	4.416	7.290	48.295	70.636	89.545	113.273
March	4.319	8.885	50.204	70.808	87.500	110.846
April	4.980	8.380	52.280	69.200	87.500	116.840
May	5.467	7.477	54.885	68.000	85.529	115.007
June	5.145	6.839	55.115	67.769	87.212	115.615
July	5.091	7.097	55.000	66.980	90.180	116.000
August	5.315	7.753	57.593	65.212	98.370	116.000
September	6.580	.....	67.640	.....	117.280	.....
October	6.905	.....	72.560	.....	109.440	.....
November	6.584	.....	71.521	.....	108.000	.....
December	6.382	.....	72.300	.....	113.600	.....
Year	5.471	.....	58.946	.....	97.618	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1922	1923	1922	1923	1922	1923
January	21.55	29.27	20.15	27.35	21.34	28.77
February	21.46	29.79	19.71	28.15	20.88	27.21
March	21.35	32.03	19.96	31.79	20.83	31.77
April	22.50	32.77	21.26	32.77	22.70	32.77
May	26.36	31.87	26.87	29.83	25.96	32.46
June	26.96	30.27	26.96	28.34	25.96	29.81
July	26.77	28.47	26.33	26.52	25.97	27.47
August	30.44	28.27	27.18	26.77	30.81	26.77
September	35.27	.....	34.70	.....	36.79	.....
October	35.27	.....	31.77	.....	33.40	.....
November	33.52	.....	29.37	.....	30.55	.....
December	29.87	.....	26.34	.....	27.69	.....
Year	27.61	.....	25.88	.....	26.91	.....

In dollars per long ton.

Monthly Crude Copper Production

	1923			
	April	May	June	July
Alaska shipments	6,886,159	8,693,161	7,921,680	7,160,887
Washoe smelter	19,400,000	18,100,000	18,300,000	17,100,000
Calumet & Arizona	3,520,000	2,868,000	3,548,000	3,492,000
Calumet & Hecla	(c)	(c)	(c)	(c)
Other Lake Superior	(c)	(c)	(c)	(c)
Chino	3,880,694	4,539,540	3,995,788	(c)
East Butte	(c)	(c)	(c)	(c)
Inspiration	(c)	(c)	(c)	(c)
Miami	5,017,000	5,557,000	5,702,000	5,164,000
Nevada Consolidated	4,492,031	5,052,379	5,258,919	(c)
New Cornelia	3,155,615	3,631,906	3,497,788	3,183,192
Old Dominion	3,271,600	2,187,000	2,285,000	(c)
Phelps Dodge	7,666,000	8,947,000	7,965,000	8,478,000
Ray	4,968,288	5,951,344	5,408,067	(c)
Shattuck Arizona	(c)	(c)	(c)	(c)
Southwest Metals Co.	906,982	1,000,000	1,185,385	.....
United Verde	(c)	(c)	(c)	(c)
United Verde Extension	3,759,160	3,759,012	3,517,744	3,579,748
Utah Copper	14,162,164	16,547,445	16,936,814	(c)
Others, estimated	10,500,000	16,000,000	14,900,000	12,000,000
Total United States	.....	.....	.....	.....
Imports: Ore and concentrates, matte	12,320,004	12,992,447	7,293,299	.....
Imports of black and blister, unrefined	7,643,962	29,961,531	46,540,898	.....
Imports of refined and old	17,186,044	38,150,650	10,971,718	.....
Grand total	.....	.....	.....	.....
Backus & Johnston	(c)	(c)	(c)	(c)
Boleo	1,519,245	1,389,150	1,484,421	1,409,649
Cananea	(c)	(c)	(c)	(c)
Cerro de Pasco	(c)	(c)	(c)	(c)
Chile	(c)	(c)	(c)	(c)
Cons. M. & S. of Canada	(a)	(a)	(a)	(a)
Falcon Mines	510,000	516,000	448,000	(c)
Furukawa	3,023,738	2,634,156	2,806,506	(c)
Granby Cons	3,217,577	2,771,179	3,199,366	2,485,651
Katanga	8,531,145	9,012,405	0,606,050	12,612,600
Mount Morgan	930,000	.....	900,000	(c)
Mount Lyell	.....	1,128,000	824,000	(c)
Phelps Dodge Mexican	3,940,000	3,688,000	3,579,000	2,726,000
Sumitomo	2,663,750	2,643,944	3,565,169	2,372,289
Wallaroo & Moonta	208,026	609,793	302,585	(c)

Comparative Monthly Copper Production

	1920	1921	1922	1923
January	121,903,744	90,596,597	32,010,292	(b) 112,341,000
February	117,540,000	86,682,941	45,957,530	(b) 102,641,000
March	120,309,316	91,046,345	55,705,760	(b) 122,202,000
April	116,078,871	46,946,523	(b) 76,601,000	(b) 117,914,000
May	114,964,207	25,310,511	(b) 88,714,000	(b) 124,785,000
June	116,107,856	24,623,693	(b) 93,740,000	.....
July	109,729,610	22,033,739	(b) 91,000,000	.....
August	112,460,254	23,248,398	(b) 101,188,000	.....
September	104,919,562	23,855,316	(b) 96,408,000	.....
October	105,231,571	23,231,572	(b) 103,273,000	.....
November	106,700,178	28,341,442	(b) 102,845,000	.....
December	95,709,009	26,629,137	(b) 103,003,000	.....

(a) No copper produced during this month. (b) Department of Commerce. (c) Not available.

COMPANY REPORTS

Wolverine Copper Mining Co.

Copper; Michigan

A report of the operations of the Wolverine Mining Co. for the year ending June, 1923, shows the following results:

Summary of Results for the Year

Rock hoisted, tons	250,745
Rock stamped, tons	244,310
Product of mineral, lb	5,431,040
Product of refined copper, lb	3,544,879
Yield of rock treated, 14,509 lb. per ton, or per cent	0.725
Cost per ton of rock hoisted	$1.704
Cost per ton of rock stamped	1.749
	Cents
Total operating cost per pound of refined copper,	12.054
Cost of smelting, freight and marketing product, including Eastern Offices' expenses	1.986
Cost of taxes	0.700
	14.740
Depletion of orebodies	4.249
Depreciation of equipment	0.541
Total cost per pound of refined copper	19.530

Operating account follows:

Sales: 4,476,777 lb. copper at 14.832c		$663,987.78
Cost of sales:		
Copper on hand July 1, 1922	$230,303.25	
Operating expenses at mine	427,306.40	
Smelting, freight and New York and Boston expenses	70,398.60	
Taxes	24,795.94	
	$752,804.19	
Less copper on hand June 30, 1923	62,154.86	
		$690,649.33
Loss on sales of copper		$26,661.55
Less interest received		1,557.05
Operating loss for the year		$25,104.50

Balance Sheet as of June 30, 1923, is given as follows:

Assets

Investments:		
Miscellaneous stocks and bonds, at cost		$95,154.73
Current assets		482,231.19
Unexpired insurance		1,360.26
Option on mineral lands		5,000.00
		$583,746.18
Capital assets (book value):		$4,100,594.36
		$4,684,340.54

Liabilities

Capital stock		
Paid in on 60,000 shares		$780,000.00
Current liabilities		44,882.28
Unrealized appreciation	$414,858.55	
Reserve for depreciation	705,591.73	
Reserve for depletion	2,493,171.08	
		3,613,621.36
Suspense		27,365.59
Surplus and realized appreciation		
Balance, July 1, 1922	$304,878.21	
Add appreciation realized during the year	108,507.82	
		$413,386.03
Deduct operating loss	$25,104.50	
Depreciation	19,181.23	
Depletion	150,628.99	
	$191,914.72	
		$218,471.31
Balance, June 30, 1923		$4,684,340.54

Eliminating depreciation and depletion from "Copper on hand July 1, 1922," and "Copper on hand June 30, 1923," as they appear in the "Profit-and-Loss Account" on page 7 of the report, the company would show a profit for the year of $21,817.57, instead of a loss of $26,661.55 on sales of copper.

For several years stockholders have been advised of the small unmined area in the Wolverine mine, and the last annual report states that of the total rock hoisted 37 per cent was secured from the footwalls in old stopes that had before been considered too low in copper content to mine. With the existing shortage of labor and high costs, it now appears necessary to concentrate mining efforts upon the small remaining rich part of the mine.

Options have been secured on 320 acres of mineral ground on the Kearsarge lode which the company believes can be developed, with the Mohawk Mining Co.'s assistance, for the mutual benefit of both companies. The ground covered by these options is at much greater depth than the present lower boundary, which boundary with the dip of the lode is 3,400 ft. below surface. It will be necessary to establish a different type of mining, and this should be profitable provided the operators find the same mineralization in this lower 320 acres that were found in the original 320 acres.

Wolverine's financial position as stated in the report shows its inability to finance this development, and the report also shows that $10,350,000 has been declared in dividends. These dividends were earned from the mining of the original 320 acres owned by the company on the Kearsarge lode.

Waihi Gold Mining Co.

Gold, Silver; New Zealand

The report of this New Zealand gold-silver mine for the year 1922 is just to hand, and shows that since 1890 the output has been £13,637,000 ($65,258,000) from 7,015,000 tons of ore, and that dividends totaled £6,006,000 ($29,-170,000). The monthly returns are averaging 16,000 tons, for £26,000 ($126,000). Results for the last year may be summarized thus:

Development and exploration, ft	15,463
Deepest shaft, ft	1,788
Ore reserves, tons	709,000
Average value per ton (33.6 s.)	$8.00
Lodes or branches productive	18
Ore treated, tons	181,092
Average stamps working 270 eight-day shifts	112
Average number of tube mills working	7.5
Average assay of heads, oz., per ton:	
Gold	0.32
Silver	2.4
Treatment of ore, per cent of total:	
As sand	22.46
As slime	76.19
As concentrate	1.3
Extraction, per cent (the same average for six years)	91.65
Doré bullion refined, oz	448,964
Revenue from all sources (£325,176)	$1,579,000
Net profit (£34,362)	$165,000
Dividends paid (two) (reserve funds drawn on), (£49,590)	$240,000
Net current assets (£500,000 approximately)	$2,400,000
Total cost per ton (includes everything)	$7.70

British money has been converted to United States coinage at normal exchange: £1 = $4.86.

MINING STOCKS

Week Ended September 1, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	60½	56	56	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	1¼	1¼	1¼		
Alloues	Boston	*16	*15½	*15½	Mar. '19	1.00
Anaconda	New York	41⅞	39¾	39¾	Se.15, Oc.22, Q	0.75
Arcadian Consol.	Boston	1⅞	1⅞	1⅞		
Ariz. Com'l	Boston	9¼	9	9	July '23,	0.50
Calaveras	N. Y. Curb			2		
Calumet & Arizona	Boston	48	47	48	June '23,	1.00
Cal. & Hecla (New)	Boston	41	40½	40⅝	June '23, Q	10.00
Centennial	Boston	8	7	8	Dec. '18, SA	1.00
Cerro de Pasco	New York	41⅛	39½	39½	Jy. 19, Au. 1	1.00
Chile Copper	New York	27⅜	26½	26⅝	Se. 1, Se. 29, Q	0.62½
Chino	New York	17⅜	14⅜	16½	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2½	1⅞	1⅞		
Copper Range	Boston	29¼	28	28½	May '23, Q	1.00
Crystal Copper	Boston Curb	60	58	59		
Davis-Daly	Boston	2⅜	2⅜	2⅜	Mar. '20, Q	0.25
East Butte	Boston	5⅜	5⅜	5½	Dec. '19, A	0.50
First National	Boston Curb	35	34	35	Feb. '19, SA	0.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	Boston Curb			*60		
Granby Consol.	New York	20	18½	18½	May '19, Q	1.25
Greene-Cananea	New York	21	18	19	Nov. '20, Q	0.50
Hancock	Boston			2		
Howe Sound	N. Y. Curb	3½	3	3	Jy. 2, Jy.16	0.05
Inspiration Consol.	New York	29⅜	28	28	Se.13, Oc.1 Q	0.50
Iron Cap	Boston Curb			4½	May 23, K	0.15
Isle Royale	Boston	20½	20½	20½	Se. 1, Se. 15,	0.50
Kennecott	New York	35⅜	34	34⅛	Se. 7, Oc. 1,	0.75
Keweenaw	Boston			*80		
Lake Copper	Boston	2	2	2		
Magma Copper	New York	31	29½	30½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2	2	2		
Mass Consolidated	Boston	1⅜	1⅜	1⅜	Nov. '17, Q	1.00
Miami Copper	New York	24⅜	24	24	Se. Oc.1, Q	0.50
Michigan	Boston	2	2	2		
Mohawk	Boston	43	41	43	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	9½	9	9½	Je. 8, Je. 30, Q	0.50
Nevada Consol.	New York	12¼	11½	11⅝	Sept. '20, Q	0.25
New Cornelia	Boston	17⅞	17⅜	17⅜	Au. 3, Au. 20, Q	0.25
North Butte	Boston	2⅜	2⅛	2⅜	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*65	*59	*64		
Old Dominion	Boston	18	17	17	Dec. '18, Q	1.00
Osceola	Boston	33	31	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†160	†150		Je. 20, Jy. 2 Q	1.00
Quincy	Boston	28	25	27	Mar. '20, Q	1.00
Ray Consolidated	New York	11	10⅛	10⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*75	*65	*65		
St. Mary's Min. Ld.	Boston	34	31	34	Mar. '23, K	3.00
Seneca Copper	New York	7⅞	7½	7⅞		
Shannon	Boston	⅜	⅜	⅜	Nov. '17, Q	0.25
Shattuck Arizona	New York			7	Jan. '20, Q	0.25
South Lake	Boston			*98		
Superior & Boston	Boston	*98	*95	*98		
Tenn. C. & C. cfs.	New York	9⅛	9⅛	9⅛	Je.30, Jy. 16, Q	0.25
Tuolumne	Boston			1½	May '13,	0.10
United Verde Ex.	N. Y. Curb	30	29	29	Jy. 5, Au. 7, Q	1.00
Utah Consol.	Boston	1⅜	1⅜	1⅜	Sept. '18,	0.25
Utah Copper	New York	62	59½	60	Je. 8, Je. 30, Q	1.00
Utah Metal & T.	Boston	*60	*50	*50	Dec. '17,	0.30
Victoria	Boston	*80	*80	*80		
Winona	Boston			*60		
Wolverine	Boston	7	6¾	6¾		
NICKEL-COPPER						
Internat. Nickel	New York	13⅛	12⅞	12⅞	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	79½	78	78	Jy. 19, Au. 1	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh			3⅞		
National Lead	New York	132	123¾	127½	Se.16, Se.29 Q	2.00
National Lead pfd.	New York			113¼	Au. 24, Se.15 Q	1.75
St. Joseph Lead	New York	19⅛	19	19⅛	Se.9, Se.20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	9	8⅛	9	May '20,	1.00
Am. Z. L. & S. pfd.	New York	35½	35	35½	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	5⅛	5⅛	Mar. '23,	0.50
Butte & Superior	New York	17½	15½	16	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	5⅛	5	5	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb			152	Jy.31, Au.10 Q	2.00
United Zinc	N. Y. Curb			*50		
Yellow Pine	Los Angeles	*62½	*62½	*62½	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb			2½		
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*39½	*29½	*29½	May '20, K	0.03
Candelaria	N. Y. Curb	*6	*5	*6		
Castle-Trethewey	Toronto	*29½	*24½	*24½		
Coniagas	Toronto	2.70	2.70	2.70	May '21, Q	0.12½
Crown Reserve	Toronto	*60	*51	*60	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	*10	*5	*8		
Kerr Lake	N. Y. Curb	2¼	2⅛	2¼	Jy. 2, Jy. 16, Q	0.12½
La Rose	Toronto	*31	*31	*31	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*18½	*16	*16½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.70	2.50	2.70	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅜	5⅛	5⅜	Jy. 1, Jy.20 Q	0.15
Ontario Silver	New York			3⅜	Jan. '19, Q	0.50
Temiskaming	Toronto	*38	*36	*38	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York			⅛		
Boundary Red M.	N. Y. Curb			*12		
Carson Hill	Boston	5⅛	5⅛	5⅛		
Cresson Consol. G.	N. Y. Curb	3 7/16	3⅜	3 7/16	July '23	2.00
Dome Mines	New York	37⅝	34½	37	Je.30, Jy.20 Q	1.00
Golden Cycle	Colo. Springs	1.06	1.05	1.06	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	11.70	11.60	11.60	Se.15, Oc.5, M	0.05
Homestake Mining	New York			58	Au.20, Au.25 M	0.50
Kirkland Lake	Toronto	*36	*32	*36		
Lake Shore	Toronto	3.30	3.30	3.30	Au.1 Au.15'23, Q	0.02
McIntyre-Porcupine	New York	16½	16	16½	Au.1, Se.1, Q	0.25
Portland	Colo. Springs	*39	*38	*38	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1½	1 1/16	1⅛		
Tom Reed	Los Angeles	*55	*55	*55	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1⅛	1⅛	Jy. '28, Q	0.15
Vipond Cons.	Toronto	*70	*57	*70		
Wright-Hargreaves	Toronto	3.15	3.15	3.15	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb			1¼	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb			*12		
Con. Cortez	N. Y. Curb	*72	*70	*71		
Con. Virginia	San Francisco	10⅛	10¼	10½		
Continental Mines	N. Y. Curb	5⅛	5⅛	5⅛		
Dolores Esperanza	N. Y. Curb	1½	1 1/16	1½	Jy. 1, Jy.10 Q	0.05
Jib Consol	N. Y. Curb			*65		
Tonopah Belmont	N. Y. Curb	*65	*65	*65	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*50	*50	*50	May 23	0.10
Tonopah Extension	N. Y. Curb	2 1/16	2	2⅛	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	1 3/16	1⅛	1 1/16	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb	3⅛	3	3⅛		
West End Consol.	N. Y. Curb	*82	*79	*80	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston			16½	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*52	*47½	*52	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅜	3⅜	3⅜	Au. 1, '23, Q	0.10
Columbus Rexall	Salt Lake	*37½	*35	*36½	Aug. '22,	0.03
Consol. M. & S.	Montreal	27	26	27	Oct. '20, Q	0.62½
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Se. 15, Oc. 2	0.125
Federal M. & S.	New York	10	9¾	10	Au. 25, Se. 15	1.75
Federal M. & S. pfd.	New York	41½	39½	41½	June '23, Q	1.75
Florence Silver	Spokane	12	10	12	Apr. '19, Q, X	0.01½
Hecla Mining	N. Y. Curb	6¾	6½	6⅝	Au.15, Se.15	0.15
Iron Blossom Con.	N. Y. Curb			*24	July 16,	0.02½
Marsh Mines	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Park City	Salt Lake	2.90	2.90	2.90	Je.15, Jy.2 Q	0.12½
Park Utah	N. Y. Curb			3	Je.15, Jy.2 Q	0.15
Prince Consol.	Salt Lake			*1	Nov. '17,	0.02½
Silversmith	Spokane	*35	*35	*35	Jy. 2, Jy. 10	0.02
Simon Silver-Lead	N. Y. Curb			*15		
Snowstorm Silver-L.	N. Y. Curb			*43		
Tamarack-Custer	Spokane	1.20	1.15	1.20	Je.30, K	0.02
Tintic Standard	Salt Lake	2.97½	2.90	2.97½	July '23	0.15
Utah-Apex	Boston	3⅛	3	3⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	55¾	52	53⅛	Se. 1, Oc. 1 Q	1.25
Char. Iron	Detroit			⅛		
Char. Iron pfd	Detroit			1⅞		
Colorado Fuel & Iron	New York	32	28	30¾	Au.10, Au.'25 Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb.'23, Q	2.00
Gt. North'n Iron Ore	New York	31⅛	30⅛	31	Apr. '23	1.00
Inland Steel	N. Y. Curb			46½	Au.15, Se.1'23 Q	0.62½
Mesabi Iron	N. Y. Curb			6⅛		
Replogle Steel	New York	13¾	12¾	13¼		
Republic I. & S.	New York	49⅞	47½	47⅝	May '2!	1.50
Republic I. S. pfd.	New York	93½	92½	92½	Se.15, Oc.1 Q	3.75
Sloss-Sheffield S. & I.	New York	49	47½	48⅛	Feb. '21	1.50
Sloss-Shef. S. & I. pfd.	New York	78	78	78	Je. 22, Jy. 2 Q	1.75
U. S. Steel	New York	94	91⅞	92⅜	Au.30, Se.29, Q	1.25
U. S. Steel pfd.	New York	117½	116¼	117	Au.7, Au.30 Q	1.75
Virginia I. C. & C.	New York			56½	Je.16, Jy. 2	2.00
Virginia I.C.&C. pfd.	New York			78½	Je.16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	33¾	31½	32½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	50½	50½	50⅜	Je.30, Jy.15 Q	1.50
Asbestos Corp. pfd.	Montreal			74½	Je.30, Jy.15 Q	1.75
SULPHUR						
Freeport Texas	New York	15⅛	11⅞	14⅛	Nov. '19, Q	1.00
Texas Gulf	New York	60⅞	58½	58½	Se.1, Se.15 Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb			3		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	44½	43⅞	44	Au. 20, Se. 1	0.75
Amer. Metal pfd.	New York			110	Au. 18, Se 1	1.75
Amer. Sm. & Ref.	New York	60½	58⅜	59⅜	Jy. 9, Au. 1	1.25
Amer. Sm. & Ref. pfd	New York	97½	96	97⅛	Au.10, Se.1 Q	1.75
U. S. Sm. R. & M.	New York	26½	23⅜	26	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	42⅜	41½	42½	Jy.6, Jy.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M. Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Advances—Heavy buying movement in steel rails. Railway ties tending higher. Railroad equipment prices firm. Cast-iron pipe higher in New York. Steel structurals firm at $2.50 per 100 lb., Pittsburgh. August steel business slower than for any previous month since October, 1921. Prices hold despite dullness of market. Lime, hydrated and lump, higher in Boston.

Declines—Lumber demand slack, due to seasonal dullness. Production and shipments low; stocks large; plenty of cars. August market weaker than month preceding. Fire, air and steam hose declined during month; rubber belting also lower. Linseed oil, raw, down to 96c., f.o.b. New York, as against $1.05 per gal. (5 bbl. lots) one month ago. Sodium cyanide and litharge declined slightly during month.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3.00	$4.45	$4.15	$5.25	$4.59
Black					
No. 28	3.85	5.20	5.20	5.80	5.15
Galvanized					
No. 28	5.00	6.35	6.35	6.50	6.15

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh—Current	Pittsburgh—One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$40.00	.....	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh—Current	Pittsburgh—One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$3.15	$2.35@2.50	$3.00	$4.00	$4.00	$3.75
Track bolts	4.00@4.25	3.25@3.50	4.00	5.00	5.00	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4 00	3.10

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.50	$2.75	$3.64	$4.20	$3.45	$3.40	$3.60
Channel, 3 to 15 in.	2.50	2.75	3.64	4.20	3.45	3.40	3.60
Angles, 3 to 6 in., ¼ in. thick	2.50	2.75	3.64	4.20	3.45	3.40	3.60
Tees, 3 in. and larger	2.50	2.75	3.64	4.20	3.50	3.40	3.60
Plates	2.50	2.75	3.64	4.30	3.45	3.40	3.60

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
BUTT WELD	..1 to 3	62	50½	¼ to 1½	30	13
LAP WELD	..2½ to 6	59	47½	2½ to 4	26	11

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black—New York	Black—Chicago	Black—St. Louis
2½ to 6 in. lap welded	44%	47%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York—Current	New York—One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$63.60	$55.30	$49.00	$60.20	$57.60	$62.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	List net	$2.75	$2.50
Cold punched, sq., per 100 lb. Off list	List net	2.75	2.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York—Current on Trucks	New York—One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1263	$0.1112	$0.0724	$0.135	$0.089	$0.108	.....
6x12x12	.1895	.1667	.0996	.....	.122	.156	.....
8x12x12	.2369	.2084	.1358	.23	.162	.244	$0.3613

MACHINE BOLTS—	New York	Cleveland	Chicago
1½ and 1½x3 in. up to 12 in.	15 %	50%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$37.00	$38.00	$39.00	$42.00
3x6 and 8	37.00	38.00	39.00	42.00
4x4-6 and 8	37.00	38.00	39.00	42.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York—20 Ft. and Under	New York—22-24 Ft.	Chicago—20 Ft. and Under	Chicago—22-24 Ft.
3x4 to 8x8	$50.00	$51.00	$45.50	$47.50
3x10 to 10x10	54.00	55.00	51.50	53.50
3x12 to 12x12	58.00	59.00	58.50	60.50

Other Cities	8 x 8-In. x 20 Ft. and Under—Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under—Pine	Fir
Boston	$65.00	.....	$60.00	$60.00	$82.00	.....
Cincinnati	40.00	$75.00	75.00	90.00	44.00	$80.00
Denver	42.00	43.25	43.25	43.25	.....	44.25
Minneapolis	.....	42.50	41.50	.....	44.00	44.75
Kansas City	43.25	.....	.....	.....	56.25	.....
Birmingham	30@35	.....	.....	.....	40@45	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.45	$4.25	$4.25	$3.34	$4.95
Cut	....	5.50	5.80	5.75	3.74	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.70@2.80	$2.70@2.80	$2.60
Chicago, f.o.b.	2.20	2.20	2.20
Cleveland, f.o.b.	2.46	2.46	2.59

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel 280-lb. net Finishing	Lump, per Barrel 280-lb. net Common
New York	$18.20	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	.....	.....	(180-lb net) 2.10

LINSEED OIL—These prices are per gallon:

	New York—Current	New York—One Year Ago	Chicago—Current	Chicago—One Year Ago
Raw in barrel (5 bbl. lots)	$0.96	$0.91	$1.14	$0.99

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry—Current	Dry—1 Yr. Ago	In Oil—Current	In Oil—1 Yr. Ago
Red	14.00	12.50	15.50	14.00
White	14.00	12.50	14.00	12.50

HOSE—

Fire		50-Ft. Lengths
Underwriters' 2½-in. coupled		53c per ft.
Air		
¾-in., per ft.	First Grade	Second Grade
	3 ply $0.33	4 ply $0.25

Steam—Discounts from List

First grade..... 40–5% Second grade....45% Third grade.... 50%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition.....60–5% Best grade..... 50–10–5%

LEATHER BELTING—List price, 2c. per sq. in. per ply.

Grade	Discount from list
Medium	30–10%
Heavy	20–5–2½%

RAWHIDE LACING—For cut, best grade, 40%, 2nd grade, 50%. For laces in sides, best, 48c. per sq.ft.; 2nd, 43c. Semi-tanned: cut, 40%; sides, 48c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0.90
Rubber sheet	.45
Rubber sheet. wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.20	New Orleans	$0.18½
New York	.18½	Seattle	.18
Chicago	.18	San Francisco	.18

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.225	.25
New Orleans	.195	.22
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.70
Pine oil, pure, dest. dist. f.o.b. New York	.65
Pine tar oil, ref. f.o.b. New York	.48
Pine tar oil, crude, tank cars f.o.b. Jacksonville, Fla	.32½

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.09½
Litharge, delivered New York, casks, 500 lb. lots, per 100 lb.	10.40
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.22½

NEW MACHINERY AND INVENTIONS

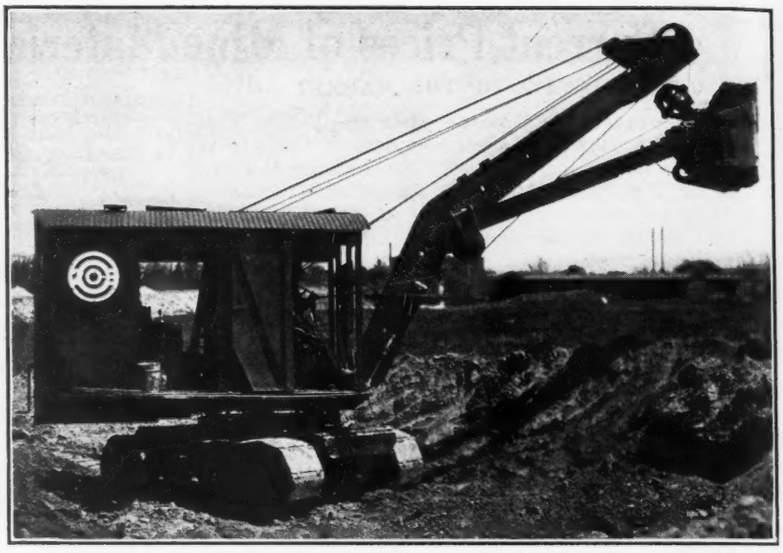
A Rope-Thrust Revolving Gasoline Shovel

A new ¾-yd. gasoline or electric rope-thrust revolving shovel, known as the 20-B, has just been announced by the Bucyrus Company, South Milwaukee, Wis. Like the 30-B shovel, which has been on the market for a year, the feature which makes this machine unique among shovels of this type is the ingenious rope-thrust arrangement, patents on which are held by the Bucyrus Company, which, the company claims, not only does away with the necessity of engines, gears, clutches, chains or complicated shafting on the boom, but at the same time gives this shovel a drive behind the thrust more powerful than it is possible to obtain with a steam shovel of the same size, as the whole power of the main engine is behind it. This device is said to have proved itself on the 30-B shovel under the toughest digging conditions in all parts of the world, and its manufacturers believe that it has literally created in itself a new era for the small shovel driven by an internal-combustion engine.

The shovel is driven by a single, rugged, slow-speed gasoline engine. The motions of the dipper handle are controlled by a small drum on a shaft under the boom, which shaft has keyed to it pinions for engaging with the racks on the handle. The drum is turned either way by two ropes wound around this drum in opposite directions, both ropes leading to drums in the main machinery. The operator can control the motions of the dipper with ease, being even able to shake it to relieve it of sticky material.

This shovel may also be had with high lift or extra high lift booms, or with dragline, clamshell, excavator, or crane attachments.

The control is simple and the machinery arranged for the convenience of the operator. Whatever clutches are necessary are sufficiently large to obviate the danger of burning. The caterpillars and frame in general are the same as in the 20-B steam machine, which is well known for its unusual strength and ruggedness.



A rope-thrust arrangement is a feature of this revolving shovel

A New Soot Blower for the Power Plant

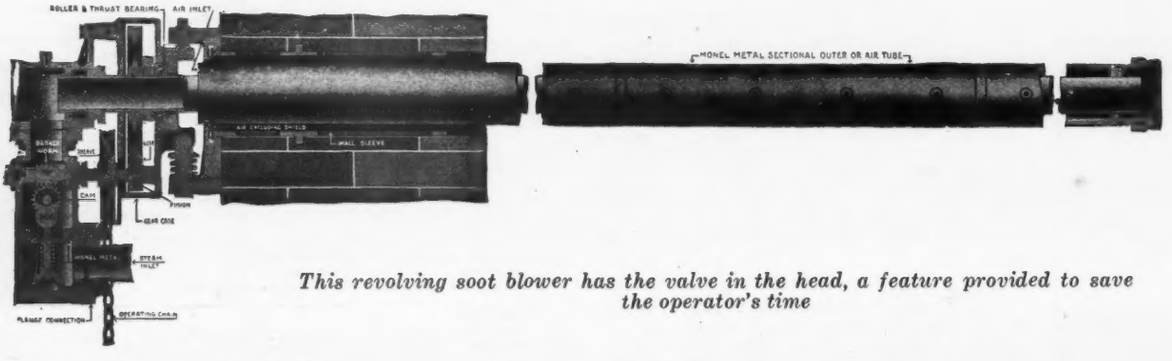
A revolving soot blower element that overcomes the temperature difficulties encountered in soot blower operation and has other valuable features has been developed by the Bayer Company, of St. Louis, Mo. The interior steam element in the blower is securely locked in a central position within the outer or sectional air tube so that both revolve as one element.

The steam element is insulated against the high furnace temperatures by liberal circulating air space. The outer air tube is kept at a comparatively low temperature due to the positive cooling effect of the circulating air passing through it. Thus, also, burning and warping are prevented. The sectional construction of the air tubes in itself is a guarantee against warping. The sections are joined together with expansion sleeves.

An important feature is the "valve-in-head" construction of the blower. By placing the valve in the head, time is saved for the operator, as he is not compelled to run around opening and closing valves. The valve automatically opens and closes at the proper points with the rotating of the element. The manufacturers claim that this valve cannot leak, because it is so constructed that it will always seat perfectly. The valve stem does not extend through a stuffing box. A stuffing box would be likely to throw the valve out of alignment with its seat and thus cause leaks. The valve is mechanically and positively controlled by a cam-and-worm gear. The valve is made of Monel metal and will not wear because of wire drawing, corrosion, or oxidation. It retains its strength at high temperatures, and a tight valve is assured at all times. To get at the valve mechanism it is not necessary to break any pipe connections. A cap at the bottom of the blower head gives access to the valve mechanism. The cap is easily removed and replaced. The only two stuffing boxes in the entire blower can be readily packed or replaced. Further, the valve is so located in the blower head that steam condensation or water cannot accumulate above the valve.

The entire head is free to expand or contract with change in temperature and with the expansion and contraction of the boiler walls or the pipe lines. For this reason there is never any straining or binding effect in the operating mechanism of the blower. The entire blower head is incased. Parts can be oiled without danger of the oil collecting dirt.

A simple and efficient reduction gear makes it impossible to revolve the unit too fast. This permits the steam jets to work most effectively on the surfaces to be cleaned during a sufficient period of time.



This revolving soot blower has the valve in the head, a feature provided to save the operator's time